Cross-Sectional Properties Q2

Contents

Basic Documentation – Overview

In addition to the individual program manuals, you will find basic explanations on the operation of the programs on our homepage www.frilo.com in the Campus-download-section.

Tip: Go back - e.g. after a link to another chapter / document - in the PDF with the key combination "ALT" + "left arrow key".

Application options

The Q2 program can be used to enter cross-sections in graphic and numerical mode, calculate their properties and display them. Tensile stresses can be excluded in the determination of the cross-sectional properties.

Note: Data import from the formely programm Q1 is possible (File ▸ Import).

You can enter data via a [graphical user interface,](#) which you might know from the FRILO Building Model.

Drawing aids such as polygon lines, circles, rectangles etc. are available for the graphical definition of the cross section outline. The user can define any cross section by combining the contour lines of various drawing elements.

The following properties can be calculated on cross sections defined this way:

- Cross-sectional area (A)
- Location of the centre of gravity (ys/zs)
- Static moments (Sy, Sz)
- Area moments of inertia (Iy, Iz, Iyz, Iys, Izs, Iyszs)
- Radii of inertia referenced to the centroidal axes (iys, izs, iyszs)
- Section moduli for extreme points referenced to the centroidal axes
- (Wys, top; Wys, bottom; Wzs, left; Wzs, right)
- Main moments of inertia (I1, I2, alpha)
- Main radii of inertia (i1, i2)
- Section moduli for extreme points referenced to the main axes
- (W1, top; W1, bottom; W2, left; W2, right)
- Deviation moment (polar moment of inertia)

The user can select the units beforehand. Available units are [*m*], [*cm*], [*mm*] for the cross-sectional properties and [*kN*], [*N*], [*MN*], [*kp*] for the loads. [*cm*] and [*kN*] are set by default.

The software application calculates the stresses in each corner point of the polygonal area. For circular and arched elements in the cross section, the maximum and minimum stresses within these elements are calculated.

The highest as well as the lowest stress are put out for the entire cross section.

The input of the loading includes moments around the y- and z-axes as well as concentrated loads with eccentricities. The loads are summed up and referenced to the centre of gravity (sum Mys, sum Mzs, sum Ns).

The cross sections are stored in the items in such a manner that they can be imported and assigned properly in the software applications ESK and RS for frameworks and DLT for continuous beams.

Stresses with exclusion of tensile strength

Starting from the basic cross section, a stress area is calculated by iteration on which either only stresses with a positive sign or only those with a negative sign occur (compressive or tensile stresses). The cross sectional border and the neutral axis limit this stress area if the neutral axis runs inside the cross section.

The entered loading refers to the new centre of gravity of the area ys'/zs' (sum Mys', sum Mzs', sum Ns).

The software application calculates the stresses at each corner point of the stress area. For circular and/or or arched elements that border the stress area, the extreme values of the stresses are put out.

The extreme values of the stresses for the entire stress area are also put out. Depending on the sign, one of the two limit values determined by approximation must be equal to zero (quality feature of numerical iteration).

Input

Graphical user interface

The software application offers a graphical user interface, i.e. elements such as outlines, block-outs, load coordinates etc. are drawn with the help of the mouse on the screen. Under normal conditions, the user must only enter the values of forces, etc. numerically in corresponding dialogs.

The user can see the defined graphical objects immediately on the screen. The hide/display options for individual elements such as load arrangements provide for a well-structured overview of even highly complex systems.

The graphical user interface itself is an independent application module, which is also integrated in the Frilo building model, for instance. The functions of the graphical user interface module are described separately in the document graphical user interface.

Numerical user interface

Of course, you can enter values and coordinates any time via numerical input fields if you need to specify them accurately, see graphical user interface.

Note: *Direct help and support referring to the current input operation is given in the form of a short comment in the status line on bottom left of the screen.*

Definition of the system of coordinates

y-axis   runs horizontally from left to right

z-axis   runs vertically from top to bottom

Moments are defined as positive if they act clockwise in axial direction.

Input of a cross section

Outer contur

The definition starts by drawing or specifying the outline of the cross section.

Rectangles, polygon lines, circles and arcs are available input functions. The drawn areas are automatically linked via a Boolean operation (addition, subtraction and intersection). If you draw two rectangles, for instance, the application combines them to a continuous area. Additional functions, such a mirroring, rotating or displacing render the input even more comfortable (menu item "Tools"). Moreover, auxiliary lines and DXF help slides are available to facilitate the definition.

You can find a detailed description in the document Graphical User Interface (chapter Auxiliary layers).

Note: *The default units are [cm] and [kN]. You can change them via the Units menu item.*

Recess

You can enter recesses/holes using the same functions as with outlines. A recess area may intersect with the outline. The intersecting area is deducted from the existing outline then.
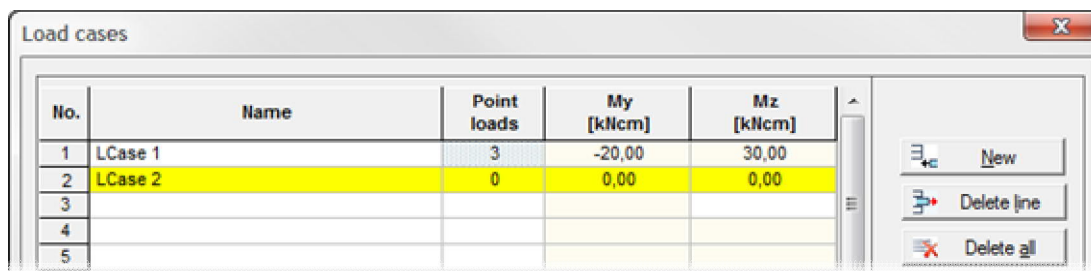
Load input

The Load input menu item provides access to the load administration and the point loads.

You can find the description of the load input functions in the document Graphical User Interface, chapter Point loads.

Entering a new load case

Click to the Load case menu item and enter a name for the load case in the displayed dialog.

The Point loads column displays the number of loads already defined for this load case.

No.	Name	Point loads	My [kNcm]	Mz [kNcm]
1	LCase 1	3	-20,00	30,00
2	LCase 2	0	0,00	0,00
3				
4				
5				

New
Delete line
Delete all

Deleting a load case

Select the load case to be deleted and click to the button Delete row. Activating the button Delete all deletes all load cases.

My / Mz

The loads acting on the cross section could be entered by specifying moments around the horizontal and vertical axes (My, Mz) in this table.

Moments are positive, if they act clockwise around the positive axes.

Moments that should act in the opposite direction must be entered with a negative sign.
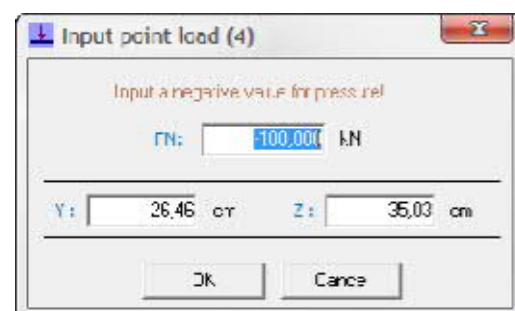
Axial force

Axial forces (A force) are positioned graphically on the cross section. The values are entered in a dialog.

See Graphical User Interface, Load input

Signs of axial forces

Tension (+)

Compression (-)

Input point load (4)

Input a negative value for press rel

FN: -100,000 kN

Y: 26,46 cm   Z: 35,03 cm

OK   Cancel

![FRILO]

Helpful functions

Drawing aids

Via the menu item Drawing aids, you can define auxiliary lines or an auxiliary grid to facilitate the definition of a complex cross section. The individual points of the auxiliary construction can be positioned accurately during the input of the outlines with the help of the Object capture function There is no need to position them accurately with the mouse.

You can find a detailed description in the document Graphical User Interface, Auxuliary geometry or Auxiliary grid.

Selecting units/dimensions

During your session, you can change dimensions and loads any time, if need be. In this case, the software application scales and adjusts the values you have entered before. The selected dimensional values are saved with the item data. When accessing the cross section of an existing item next time, you need not repeat the setting work.

Measuring

Measuring distances and angles. Click successively on the two end points of a distance to be measured. The measurement result is displayed subsequently. In most cases, it is useful to activate the Object capture function for this kind of operation.

Dimensioning

Hiding and displaying dimension lines. You can also edit the angle between the y-axis and the main dimensioning direction (default = 0).

Auxiliary DFX-layer

Auxiliary slides can be very helpful when entering outlines or block-outs/recesses in the graphical user interface.
You can enable and disable auxiliary slides by ticking and unticking the Visibility option.

 See document Graphical User Interface, Auxuliary layers
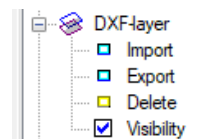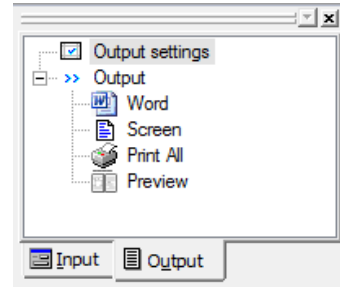

Notes/Comments

The user can enter short texts and include them in the output.

Output

The calculation is performed when user launches the output on the screen or printer.

Screen

Display of system data, cross-sectional properties or loads/stresses in the text output window on the screen.
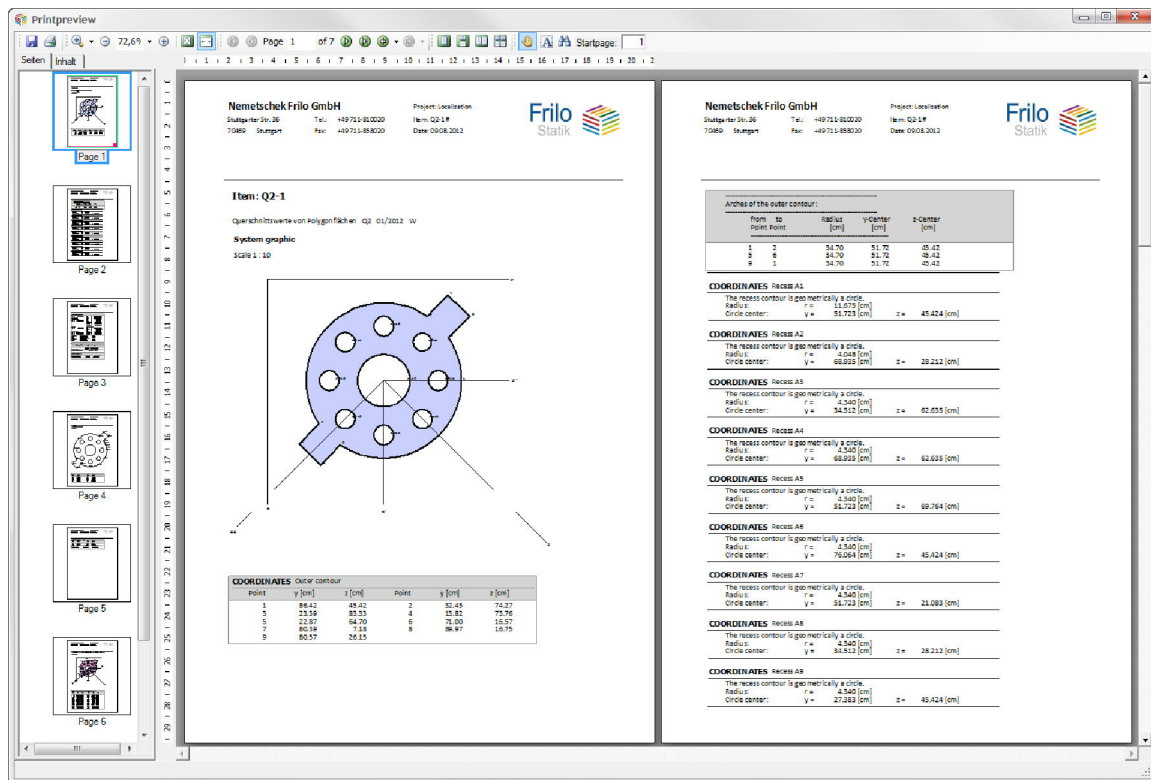
Word

Output in word in the RTF format if MS Word is installed on this computer.

Print all

Output on the printer. First, the PDF print preview is displayed. You can start printing in the preview mode.

See also Output and Printing

Settings / Output profile

Adjustment of the output scope. You can select which data/graphs should be put out.

Tick the data to be put out.

System:

Optionally selectable output of the system graph, coordinates, cross-sectional properties (area, centre of gravity, moments of inertia) and eventually existing comments.

Loading/stresses:

Output of the results of the individual load case calculations (sum of the axial forces, position of the total resultant, stresses in the corner points), optionally selectable for the currently active load case, all load cases or or the selected load cases.
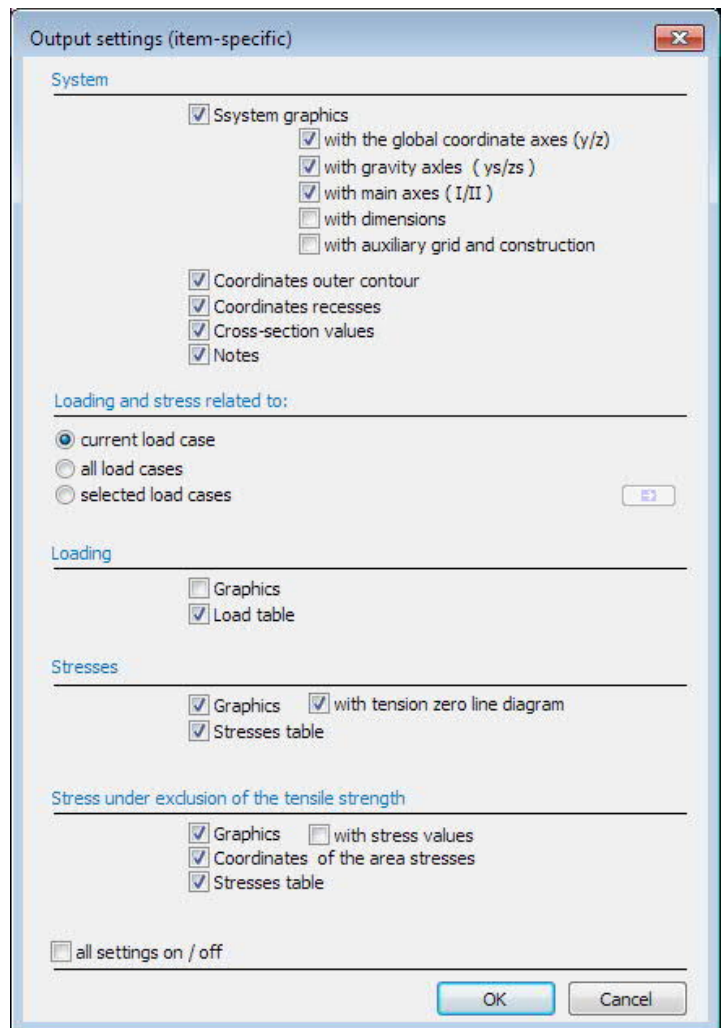
Functions in the toolbar

Hold the mouse pointer briefly over a symbol/icon to display the associated function as a tooltip.