

# Verification of Steel Cross-Sections SQN+

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## Basic documentation, hotline service and FAQ

In addition to the individual program manuals, you will find "[Basic operating instructions-PLUS\\_eng.pdf](#)" on our homepage [www.friilo.eu](http://www.friilo.eu) under CAMPUS in the download area (Manuals).

*Tip 1: If you have questions to our hotline, read [Help - Hotline Service - Tips](#).*

*Tip 2: Back in the PDF - e.g. after a link to another chapter/document - use the key combination <ALT> + "Left direction key".*

*Tip 4: Search the help file for keywords with <Ctrl> + F*

## Application options

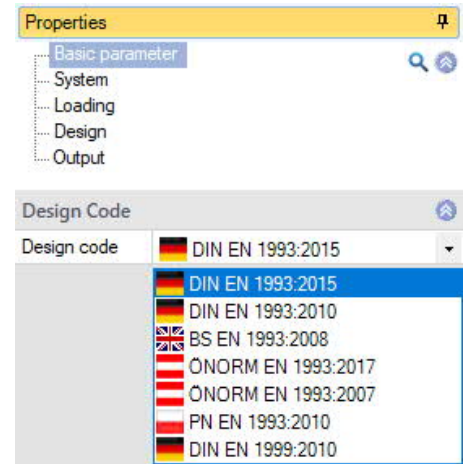
The SQN+ program can be used to carry out the cross-section verification of a steel cross-section in the ultimate limit state according to Eurocode 3.

### Standards

- DIN EN 1993
- BS EN 1993
- ÖNORM EN 1993
- PN EN 1993
- DIN EN 1999

### Assistant/Wizard

After starting the program, the [Assistant](#) (formerly called wizard) is displayed first. With the help of the Assistant, the entries required for the verification can be made quickly and easily. The basic inputs defined in this way can then be easily modified and supplemented with the help of the graphic-interactive input.



### Cross-sections

- I-sections, U- sections, T- sections, angle sections, C-sections, square pipes, round pipes, rectangular pipes, round steel and flat steel as standard sections
- I-sections, U- sections, T- sections, angle sections, C- sections, square pipes, round pipes, rectangular pipes, round steel and flat steel as user-defined sections
- Multi-part sheet plate cross-sections from the program Q3.

### Loading

- Design internal forces from axial force, moment ( $M_y$ ,  $M_z$ ), primary & secondary torsional moment ( $M_{xI}$ ,  $M_{xII}$ ), warping moment ( $M_w$ ) and shear force ( $V_y$ ,  $V_z$ ).
- It is possible to enter several design internal forces combinations.

### Material

- Structural steel: S235, S275, S355, S450
- Structural steel annealed (S275N – S460N)
- Structural steel thermo (S275M – S460M)
- Structural steel weatherproof (S235W – S355W)
- Creep resistant steel (S460Q – S460QL1)
- Hollow section warm (S235H – S355H)
- Hollow section warm N (S275NH – S460NH)
- Custom steel type
- Aluminum Sheets, Aluminum (extruded, drawn, forged and custom type)

### Verifications

- Elastic cross-sectional resistance according to DIN EN 1993-1-1, Eq.6.1
- Plastic cross-sectional resistance according to DIN EN 1993-1-1, Eq.6.2

### Output

Depending on the selection made, the results can be documented in a clear, short form or in a user-defined form.

## Calculation bases

The cross-section is verified in the ultimate limit state according to DIN EN 1993-1-1, 6.2.

According to DIN EN 1993-1-1, 5.5, the steel cross-section is classified in cross-section class 1 to 4 depending on its stress and the  $c/t$  ratio of its compression-loaded cross-section parts. The cross-section is verified according to this classification. For cross-section classes 1 to 3, the verification is carried out according to Equation 6.1 (stress verification) and Equation 6.2 (utilization of plastic resistance according to the cross-section class). Cross-section class 4 is verified with effective cross-section values.

## Quick start

### Assistant/Wizard

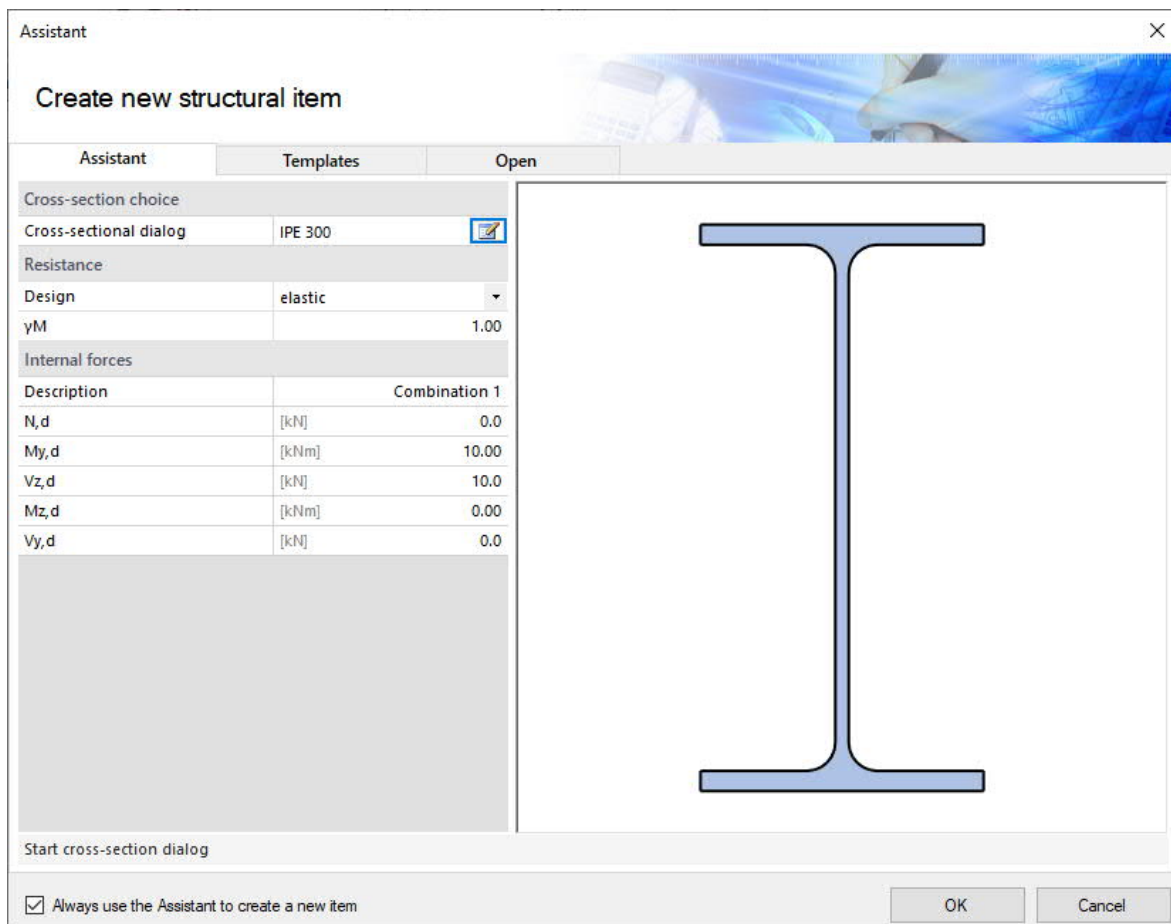
When the program starts, the [Assistant](#) (formerly called wizard) window appears automatically.

The most important key data of the system can be entered here quickly, which can then be edited in the input area and/or in the [interactive graphic interface](#).

Self-defined items can also be imported here as templates. Saving as a template is done via ▶ File ▶ Save as ▶ Select the option "Use as template".

Inputs:

- Cross section definition
- Design type
- Internal forces



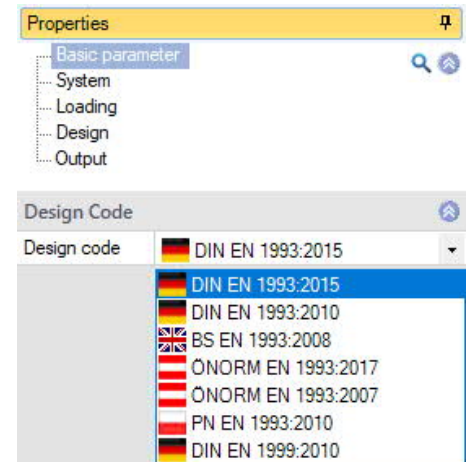
The entries in the program can then be easily supplemented and processed further.

See also [basic operating instructions-plus\\_eng.pdf](#)

## Basic parameters

### Standard and safety concept


Design standard      Selection of the design standard with National Annex.



## System

### Cross-section selection

Cross-sectional dialog

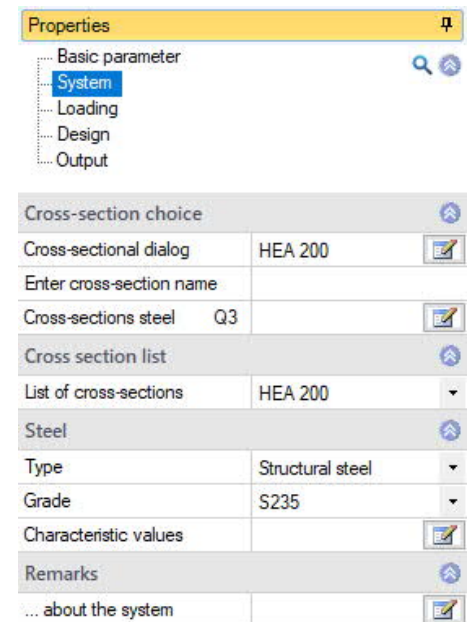
Click the edit button  to open the [cross-section selection dialog](#).

Enter cross-section name

For quick selection, you can simply enter the desired cross-section designation (e.g. "HEB200"). Thus, the cross-section dialog does not have to be called. However, this only applies to standard sections.

Cross-sections steel Q3

Starts the [Cross-Sections Steel Q3](#) program and accepts the selected cross-section (only multi-part cross-sections, no single cross-sections).  
*Note: The Q3 program determines the values for any combination of thin-walled steel construction sections.*



### Cross-section list

List of cross-sections


All cross-sections selected for this item from the sections database are offered for selection in this list. After saving and reopening the item, the cross-section list is deleted and only the last selected cross-section is available.

### Steel material


Depending on the selected standard, the type of steel or material can be selected here. There is also the option of entering a user-defined steel grade. The characteristic values can be defined here.

When choosing EN 1993, the following types of steel are available:

- Structural steel
- Structural steel annealed
- Structural steel thermo
- Structural steel weatherproof
- Creep resistant steel
- Hollow section warm
- Hollow section warm N

- User-defined type: The icon  opens a material dialog for defining the characteristic values of the steel.

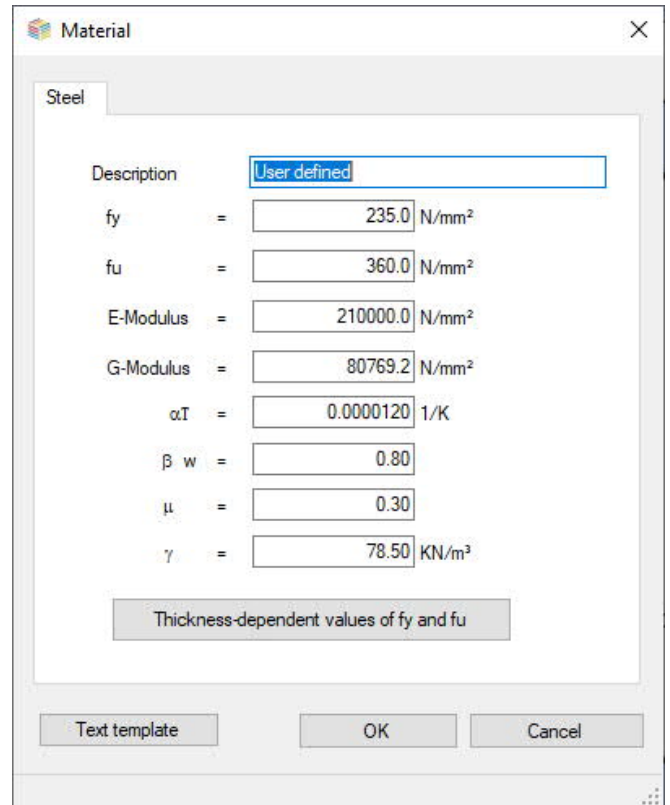
When selecting EN 1999, the following material types are available:

- Aluminum sheets
- Aluminum, extruded, drawn
- Aluminum, forged products
- Custom type: The icon  opens a dialog for defining the aluminum characteristics.

Depending on the type of material selected, there are also different alloys to choose from.

### Remarks

Enter your own [remarks](#) to the system - these then appear in the output document but can also be hidden there if you wish.



The image shows a 'Material' dialog box with a 'Steel' tab. The 'Description' field contains 'User defined'. Below this, several material properties are listed with their values and units:

Property	Value	Unit
fy	235.0	N/mm <sup>2</sup>
fu	360.0	N/mm <sup>2</sup>
E-Modulus	210000.0	N/mm <sup>2</sup>
G-Modulus	80769.2	N/mm <sup>2</sup>
αT	0.0000120	1/K
β w	0.80	
μ	0.30	
γ	78.50	KN/m <sup>3</sup>

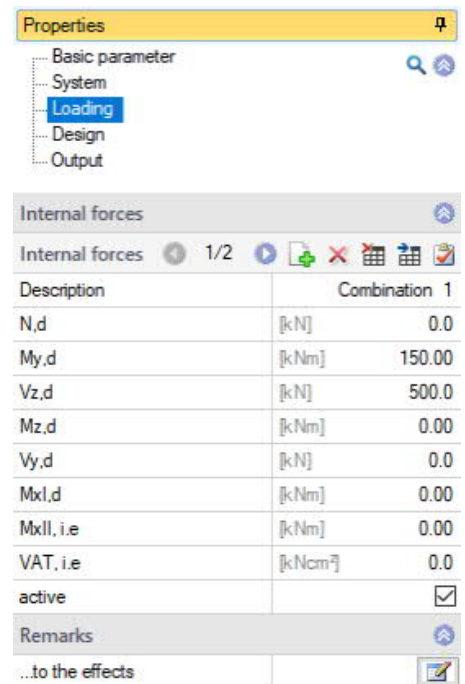
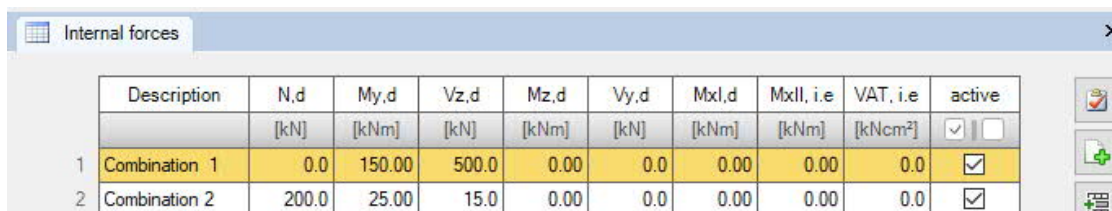
At the bottom of the dialog, there is a button labeled 'Thickness-dependent values of fy and fu'. At the very bottom, there are three buttons: 'Text template', 'OK', and 'Cancel'.

## Loading

### Internal forces

There are several options for entering the internal forces:

- 1) Entry via the left menu tree
  - 2) Input via the table ("Internal forces" tab) below the graphic
  - 3) Graphically by clicking on the loads in the graphic
- The input is made with design internal forces.
  - Several internal force combinations can be created.
  - Simply click on the green plus symbol to create a new combination.
  - The combinations can be activated or deactivated individually.

	Description	N,d	My,d	Vz,d	Mz,d	Vy,d	Mxl,d	Mxll, i.e	VAT, i.e	active
		[kN]	[kNm]	[kN]	[kNm]	[kN]	[kNm]	[kNm]	[kNcm <sup>2</sup> ]	<input type="checkbox"/>
1	Combination 1	0.0	150.00	500.0	0.00	0.0	0.00	0.00	0.0	<input checked="" type="checkbox"/>
2	Combination 2	200.0	25.00	15.0	0.00	0.0	0.00	0.00	0.0	<input checked="" type="checkbox"/>

Fig.: Tabular input via the "Internal forces" tab.

### Remarks

Enter your own [remarks](#) on the loading - these then appear in the output document.

## Design

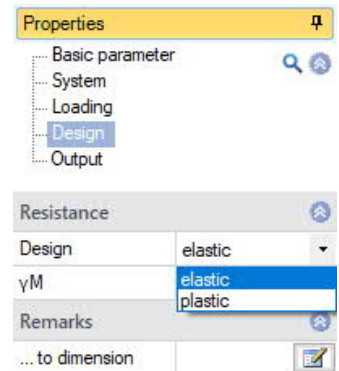
### Bearing capacity

Design type The cross-section design is based on DIN EN 1993-1-1 Equation 6.1. or according to DIN EN 1993-1-1 Equation 6.2.

$\gamma_M$  Partial safety factor on the resistance side

### Remarks

Enter your own [remarks](#) on the design - these then appear in the output document.





## Output

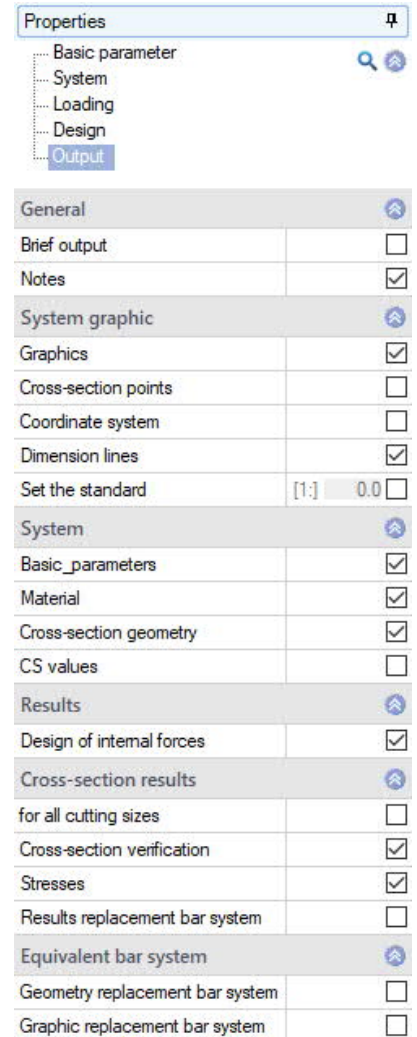
### Scope of output

By clicking on the various output options, you determine the scope of the outputs. A predefined "Brief output" can be selected.

### Output as a PDF document

The output document is displayed in PDF format via the "[Document](#)" tab and can be printed.

See also [Output and Printing.pdf](#)



## Results

### Result graphs

The "Results" tab displays the various symbols and options for displaying the result graphs. When entering several internal force combinations, the individual combinations can be selected via a drop-down menu in the "View" column. The results for the selected combination are then displayed.




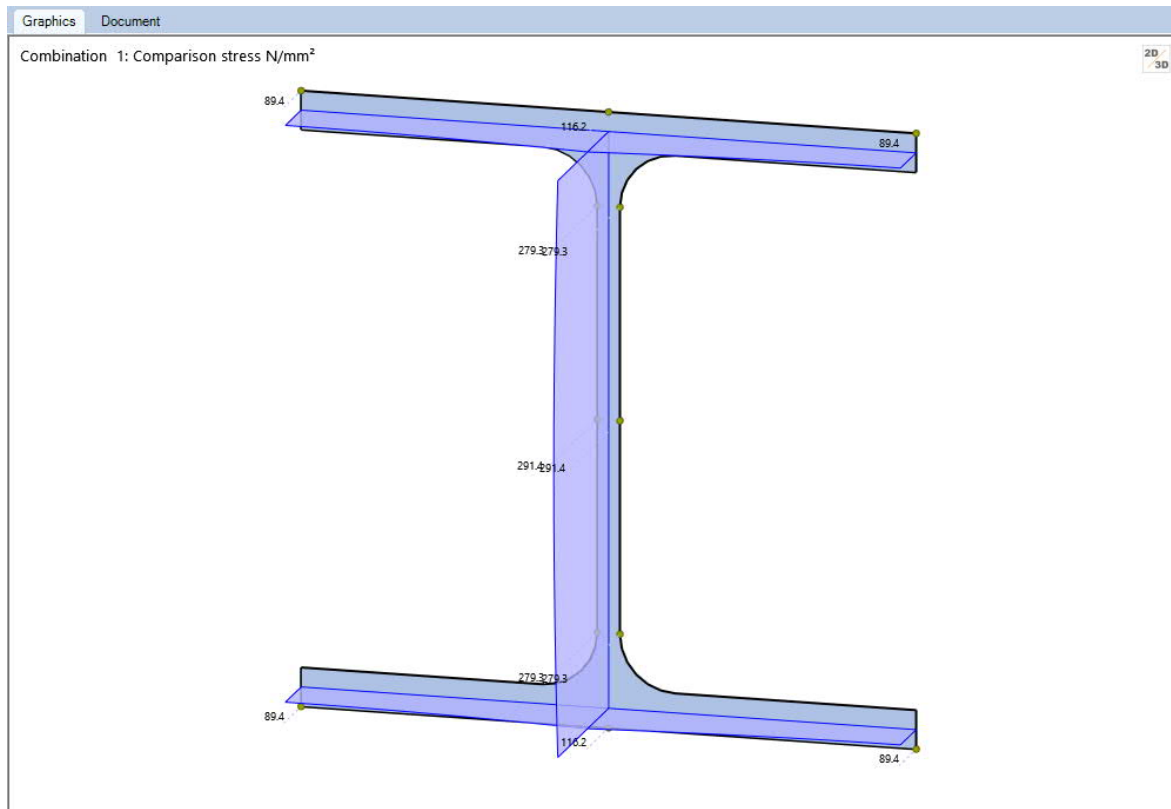
You can use the camera icon to take a snapshot of the displayed graphic and name it.

Use the icon on the right to display the list of images, which can also be deleted here.

These images are automatically transferred to the output.

## Display stress curves

Click on the icon  in the top right-hand corner of the graphics window to graphically display the stress curves at the stress points on the cross-section - see Fig.



## Literature

- [1] DIN EN 1993 [2015]
- [2] DIN EN 1999 [2010]
- [3] PETERSEN, CHR.: Stahlbau. 4., vollständig überarbeitete Auflage., Wiesbaden (Vieweg & Sohn) 2013.
- [4] KINDMANN, R. ; FRICKEL, J.: Elastische und plastische Querschnittstragfähigkeit, 1.Auflage. Berlin, Ernst & Sohn 2002