Steel Truss FWS+

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.

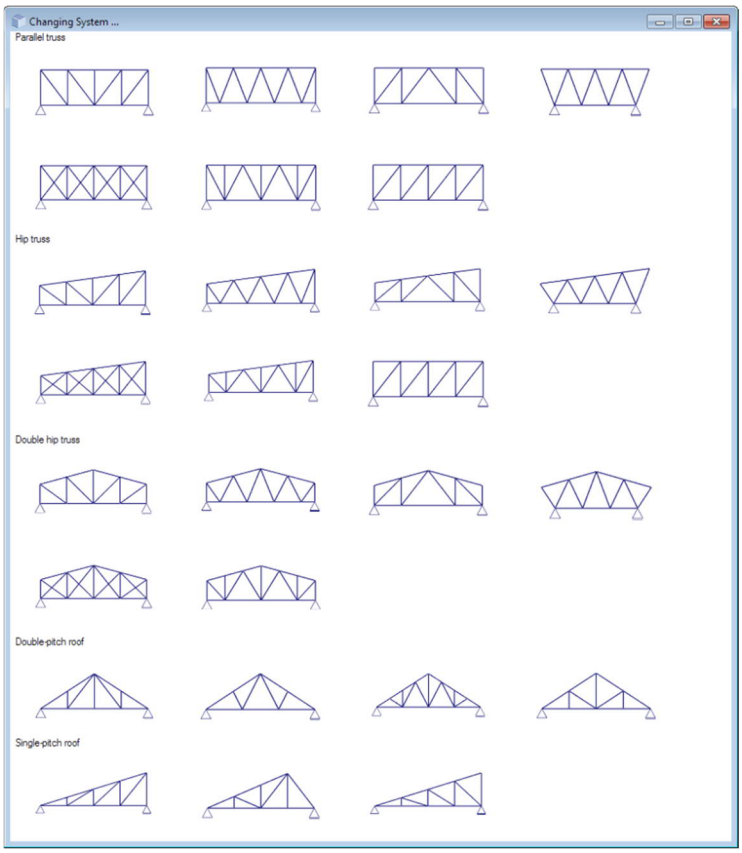
Further information and descriptions are available in the relevant documentations:

Wind and Snow Loads-PLUS	Separate description of the wind and snow loads dialog that is part of various applications.

Application options

The software is suitable for the structural calculation and design of steel trusses typical in the construction of portal frames:

- Parallel trusses
- Hip trusses
- Double-hip trusses
- Double-pitch roof trusses
- Single-pitch roof trusses



- Cross-sections and material can be defined differently for chords, posts or diagonals. This makes it possible to stagger the struts, for example, depending on the load.
- Continuous chords can be considered as flexurally rigid members.
- Member loads due to wind and snow are generated by the software.

Available standards

The FWS+ application performs structural safety analyses in accordance with EN 1993-1-1 and takes the corresponding National Annexes into account.

- DIN EN 1993
- ÖNORM EN 1993
- BS EN 1993

Snow and wind loads are based on the standards EN 1991-1-3 and EN 1991-1-4 and their National Annexes.

- DIN EN 1991-1-3:2019, DIN EN 1991-1-4:2010
- ÖNORM EN 1993-1-3:2018, ÖNORM EN 1993-1-4:2019
- BS EN 1991-1-3:2015, BS EN 1991-1-4:2011

Load transfer

You can transfer loads to the following software applications

STS+	Steel Column
HO1+	Timber Column
B5	Reinforced Concrete Column
ST4	Steel Girder Support
B9	Reinforced Concrete Corbel

Calculation / Verifications

The internal forces are determined with the help of the elastic frame method. The load combinations decisive for the design are calculated in a first-order analysis.

All necessary combinations of actions are automatically considered in accordance with the safety concept set forth in DIN EN 1990.

The verification of the cross-sectional resistance is based on the internal plastic limit forces. You can optionally select the theory of elasticity as verification method.

The component verifications (stability verifications) of the truss members are performed by the software. You can define lateral supports at the top and bottom chord perpendicular to the truss plane as well as at the vertical edge members, if any.

The software calculates the deformation of the structural system as well as the relative deformation of the individual components in the serviceability limit state in accordance with the selected design situation.

The support reactions are put out with the characteristic loads for each load case.

Load transfer

See Load transfer

Interface to BTII+ for advanced stability verifications

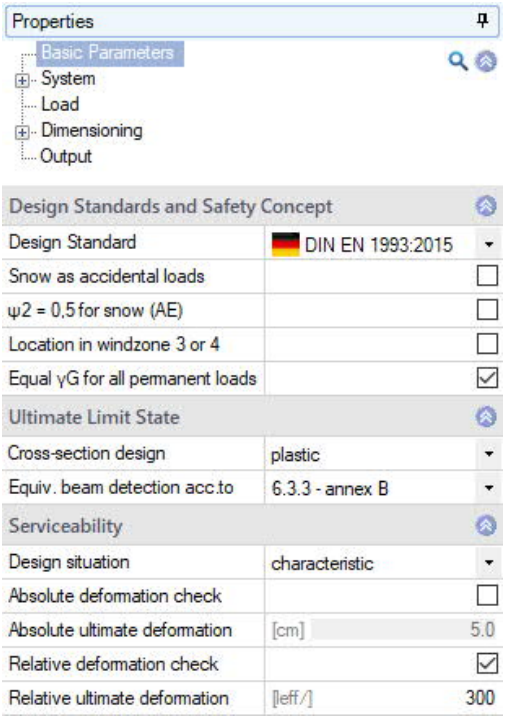
If you hold a licence for BTII+ (Lateral Torsional Buckling Analysis), you can transfer the top chord, the bottom chord and the vertical edge members, if any, to BTII+. This software application provides for the calculation of more complex systems.

Basic parameters

Standard and safety concept

Select the desired standard.

Available standards - see Application options.



Snow as accidental loads:

Check this option if the snow loads shall be included automatically not only in the typical design situations but also as an accidental action. You can either specify a load factor for the accidental snow loads or have it determined automatically by the software (select the corresponding checkbox).

ψ2 = 0.5:

Check this option to increase the value of the combination coefficient ψ2 to 0.5 for snow action in the seismic design situation.
(See introductory decree of the federal states, e.g. Baden-Württemberg)

Wind zone 3 or 4:

Check this option if the building is situated in wind zone 3 or 4. In this case, you need not consider snow as an accompanying action with wind being the leading action.

Equal γG for permanent loads:

Check this option if all permanent loads or load cases shall be included with the same partial safety factor (γG,sup or γG,inf). Otherwise, all permanent loads or load cases are combined with each other with γG,sup and γG,inf.

Ultimate Limit State

Cross-section design	optional selection whether the elastic model as per equation 6.1 or on the plastic model as per equation 6.2. should be used.
Equivalent member verification	in accordance with 6.3.3 (annex A or B) or with 6.3.4.

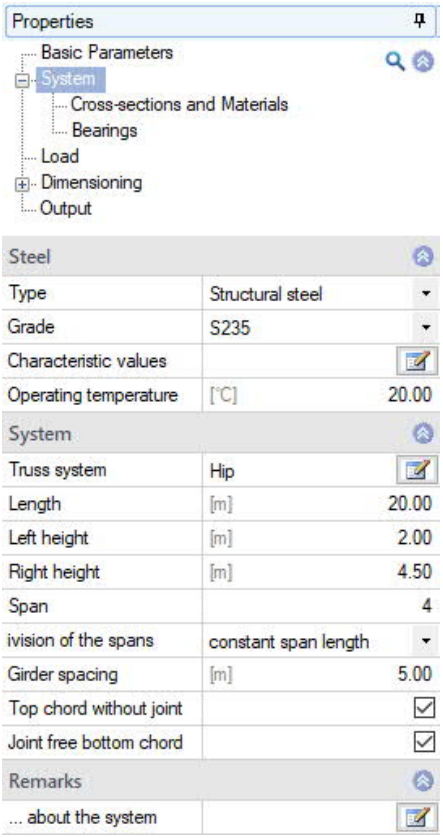
Serviceability

Design situation	select the design situation the verifications in the serviceability limit state should be based on (characteristic, frequent and quasi-permanent).
Verification absolute deformation	select this option to perform the serviceability verification with consideration of the deformation difference in relation to the undeformed system.
Absolute limit deformation	defines the permitted maximum absolute deformation of the structural system.
Verification relative deformation	select this option to perform the serviceability verification based on the effective lengths, which are determined by the turning points (moment passage) of the bending line.
Relative limit deformation	defines the permitted maximum relative deformation of the structural system.

Structural system

Steel material

Selection of the steel type and steel grade.



System

Type of truss (Truss system)

Click on the button  to select the truss shape and type.

See also: graphical representation of the types of trusses in the chapter Application options.

Depending on the selected type of truss, the associated system dimensions are displayed for selection (number of spans, height, length etc.) - additional information is available via the respective tooltips.

Division of spans

The span lengths can be of equal length (constant), symmetrical or individually defined.

Flexurally rigid ridge point

Check this option to define a ridge point that is resistant to deflection.

Bottom chord free from hinges

Specifies whether the hinge definitions also apply to the bottom chord.

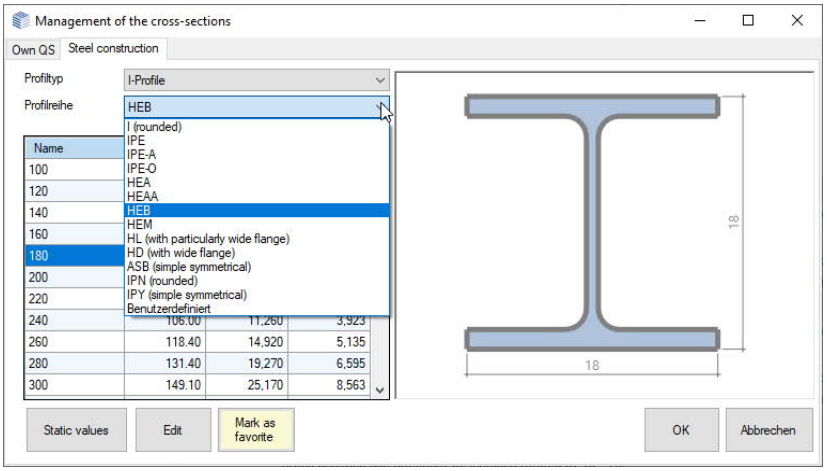
Cross-sections

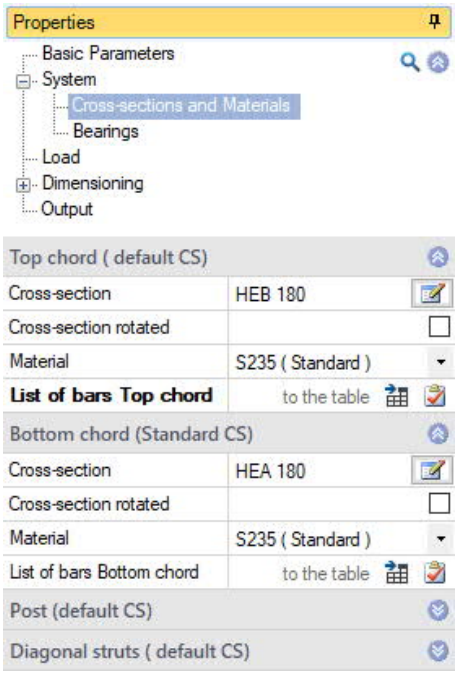
Cross-sections and material can be defined differently for chords, posts or diagonals.

Cross-sections can optionally be installed rotated by 90°.

You can obtain a clear overview using the tables in the "Bar lists" (tabs below the graphic).

Click on the  buttons to select the cross-sections.





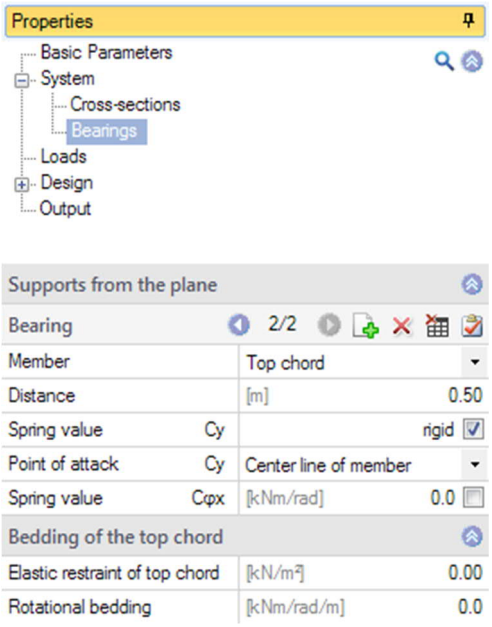
Select the cross-section either from the FRILO profile selection file or define it by specifying the dimensions. You can also edit defined cross-sections in this dialog.

See also the Selecting /Defining Cross-Sections-PLUS documentation as well as the programm Steel Cross-Sections General QS+.

Supports

Supports out of plane

Specify the supporting conditions of the different components (top chord, bottom chord, left edge, right edge).



Distance
: distance to the left or to the bottom, related to the projection plane

Spring value cy
: discrete supporting conditions for translation in the y-direction (rigid, 0 = free, >0 = elastically supported)

Application point
: available options are ‘top edge’, ‘bottom edge’ and ‘component axis’

Spring value cφx
: discrete supporting conditions for rotation around the component x-axis

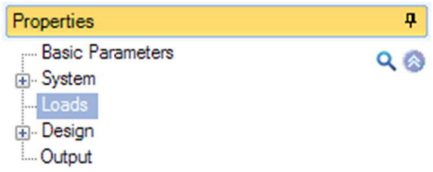
Continuous support (Bedding) of the top chord

Translational foundation top edge
: translational foundation at the top edge of the top chord in the y-direction

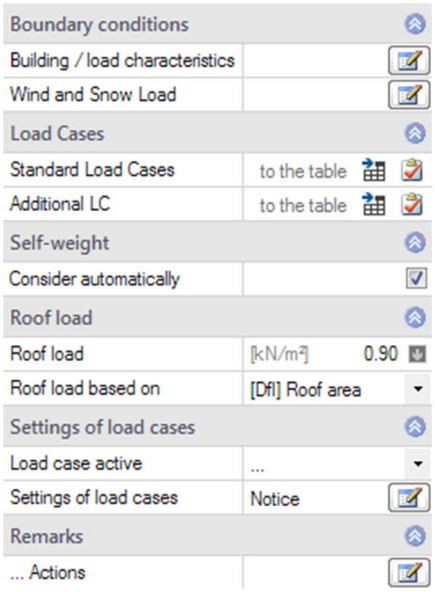
Torsional foundation
: torsional foundation of the top chord about the x-axis

Loads

Building and load parameters



Click on the  button to access the dialog of the building and load parameters.



Height above ground level

Specify the height of the bottom chord (system axis) above the top edge of the ground to consider different wind pressure values at different height levels. The wind pressure is calculated for the specified height.

Trusses

Number of trusses in the building.

Truss spacing

Specify the spacing of the trusses being the width of the load area.

Length of the building

The building length calculated from the number of trusses and their spacing is indicated.

Gable truss

This option allows you to define a gable truss. If you leave the option unchecked (default), the truss is treated as an inner truss. The option influences the selection of the wind area.

Affected width factor

Factor for the load application area on the truss.
Width of load area = factor · truss spacing.

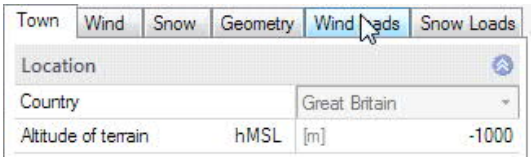
Area with increased wind load

The load application area of the truss is exposed to increased wind load at the gable.

Wind and snow

Click on the  button to display the dialog of the border conditions for the calculation of the wind and snow loads. This dialog is described in the documentation Wind and Snow Loads-PLUS.

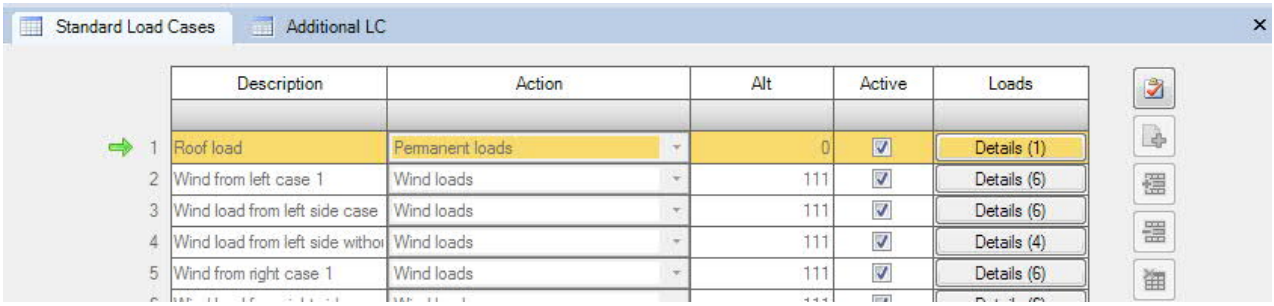
The different tabs (municipality, wind, snow...) provide access the respective dialogs and data-entry fields.



Standard/additional load cases

The load case ‘permanent’, generated by the software, as well as the wind and snow load cases are standard load cases. The wind and snow load cases are generated automatically based on the truss dimensions, the position and installation height and the snow and wind zones.

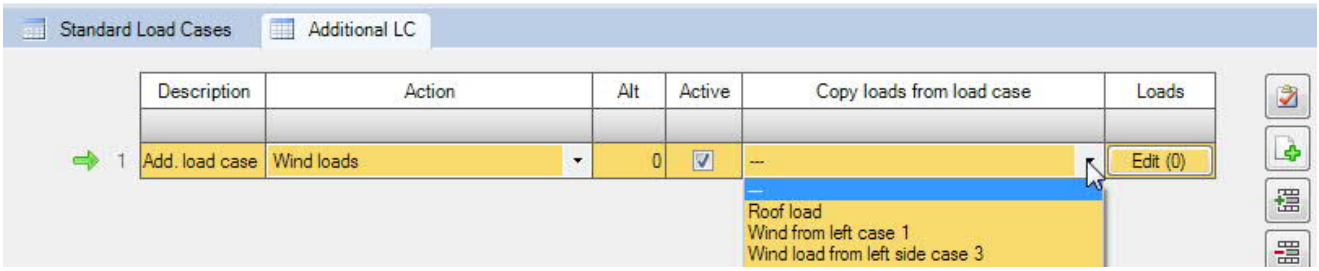
You cannot edit them, and they are newly generated each time you modify the structural system. You can disable these load cases (by clearing the checkbox).



Additional load cases

To edit standard load cases, copy them in the table ‘Additional load cases’ and edit them as required ('Copy loads from load case' column).

If you need additional load cases, you can define them in this table.



 click on this button to add a new additional load case (a new table row).

Self-weight

Check this option to include the self-weight automatically as a permanent load in the calculation.

Roof load

Enter the permanent load of the roof superstructure.

Roof load from load value summary:

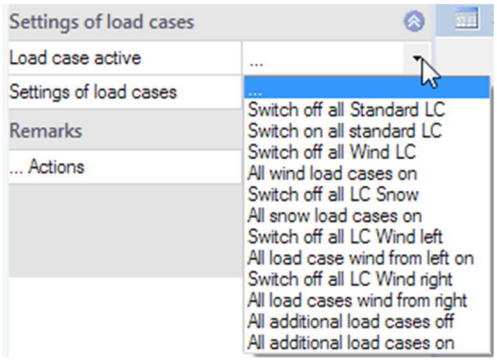
By clicking on the arrow icon you can access a load value summary - see the description of the LOAD+ application.

Select subsequently whether the roof load should be referenced to the roof area or the base area.

Load case control

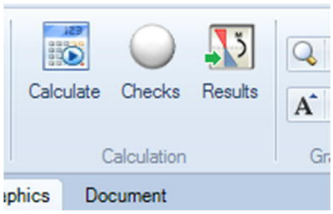
You and enable and disable load cases in this section.

Please read the tooltip below the information button.



Design

Calculate



Click on the 'Calculate' button. After completion of the calculation, the utilizations are displayed.

Load transfer

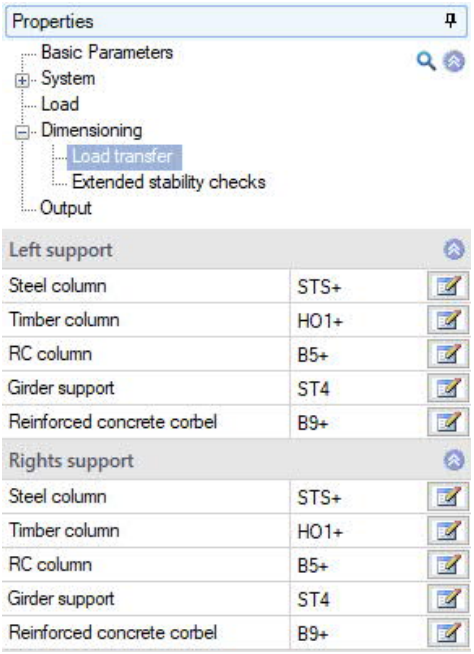
You can transfer the characteristic support reactions to the applications:

STS+ Steel Column

HO1+ Timber Column

B5+ Reinforced Concrete Column

In a intermediate dialog, parameters such as column height, height of the load application point and eccentricity can be specified.



ST4 Steel Girder Support

B9+ Reinforced Concrete Corbel

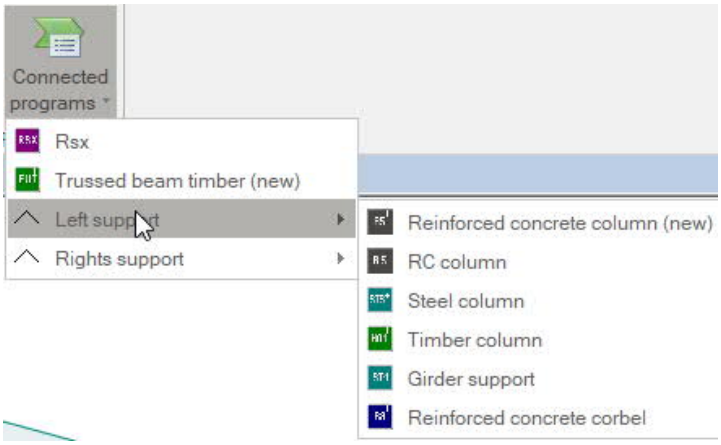
The desired combination can be selected (marked) in a dialog.

Enhanced stability verifications BTII+

If you hold a licence for BTII+ (Lateral Torsional Buckling Analysis), you can transfer the top chord, the bottom chord and the vertical edge members, if any, to BTII+. This software application provides for the calculation of more complex systems.

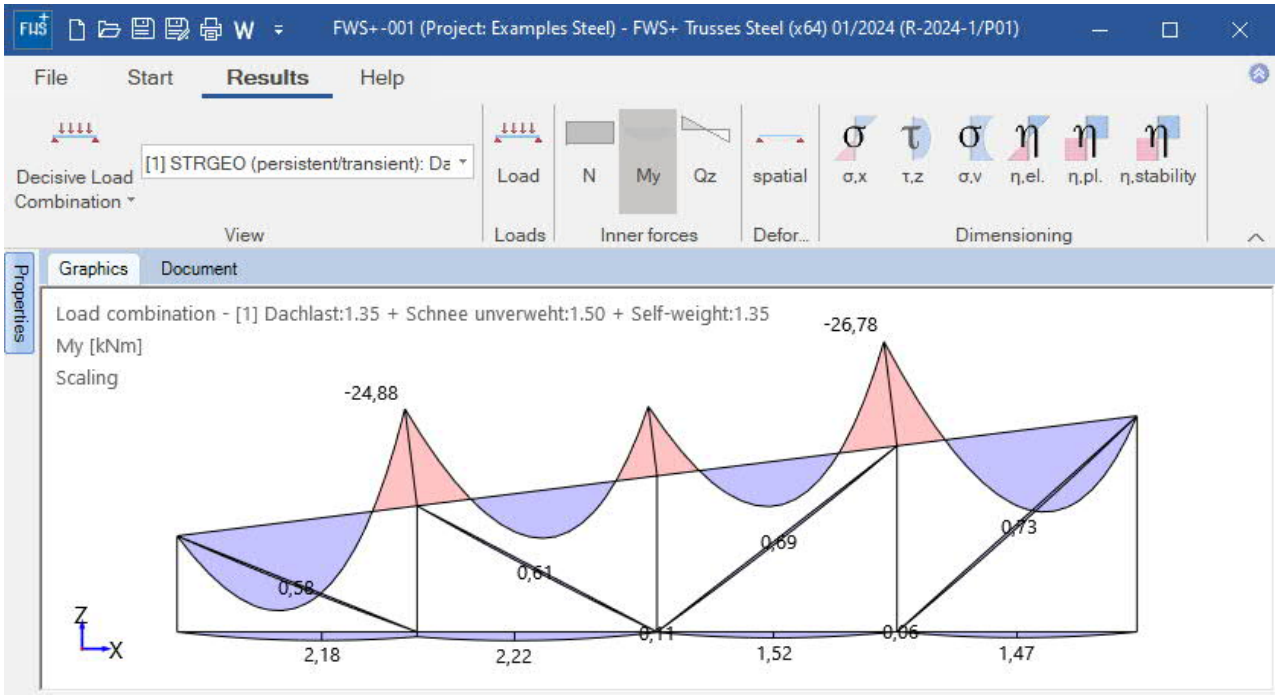
Connected programs

Here you can transfer the system to other FRILO programs such as RSX or FWH+.



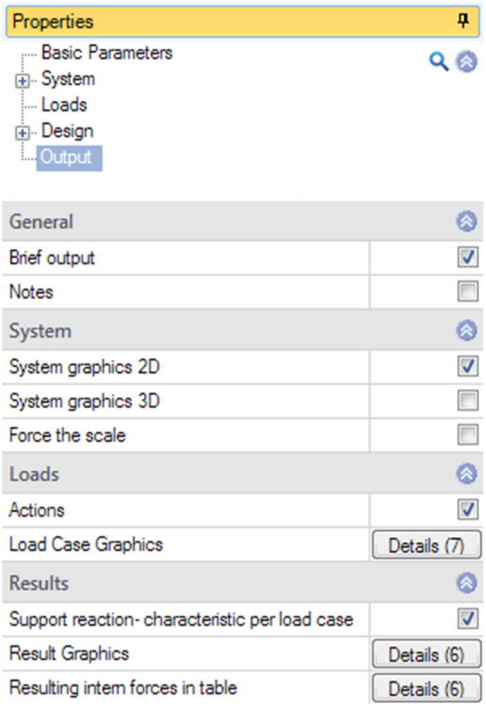
Results and output

Via the ‘Results’ tab (on top) you can display the different result graphs.



Scope of the output and options

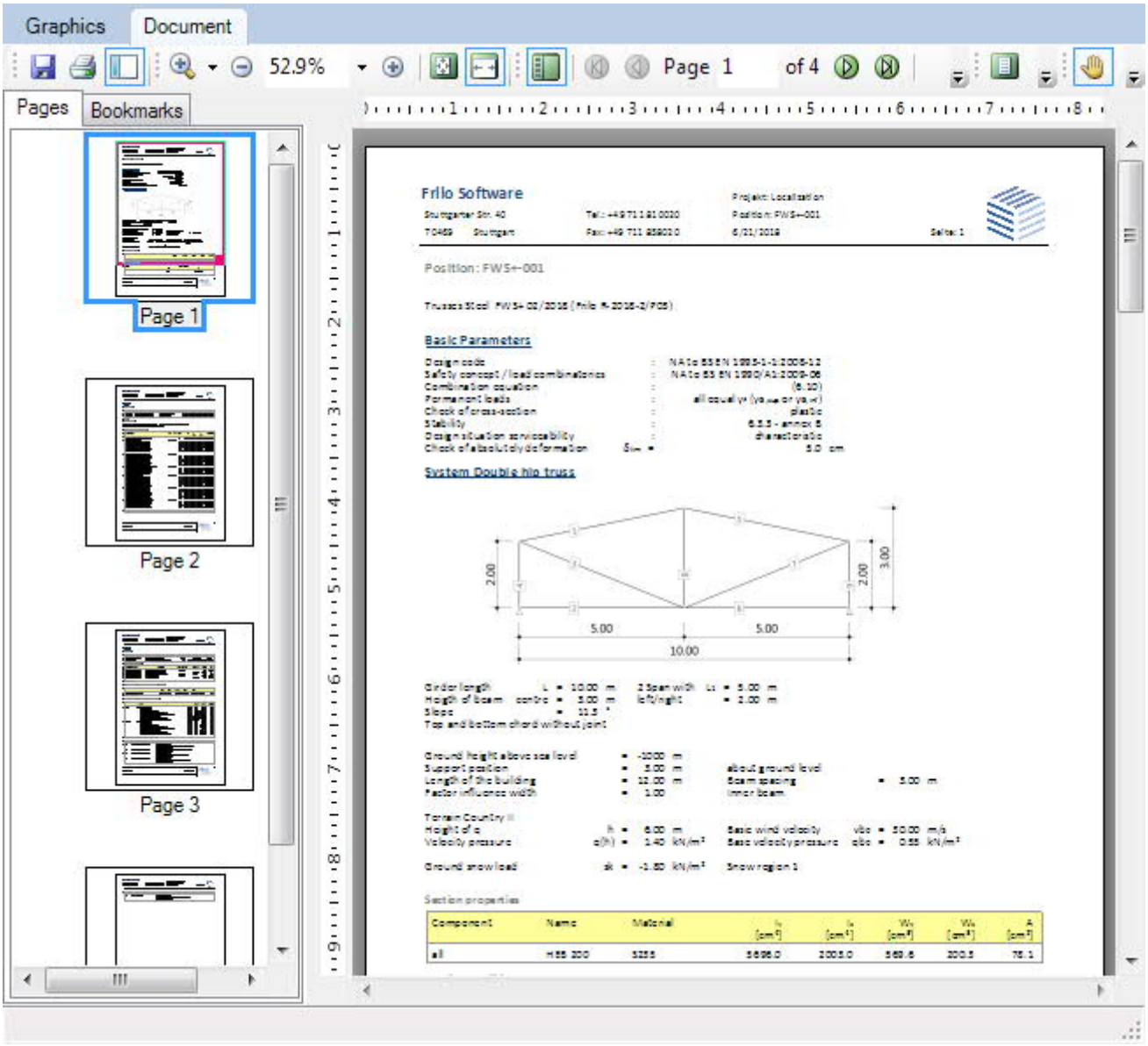
The ‘Output’ menu item allows you to define the desired scope of data to be put out by checking the corresponding options.



Output as a PDF file

The output document (PDF) can be accessed by clicking on the ‘Document’ tab (above the graphic screen).

See also the document Output and printing.



Reference literature

/1/

/2/ DIN 1052, 1996, Part 1 A1, Timber structures, Design and construction, Modifications

/3/ DIN 1055: 1978, Part 1 to 5, Design loads for buildings

/4/ DIN 1052:2004-08, Part 1, Draft, Design of timber structures - General rules and rules for buildings

/5/ DIN 1055:2001-03, Part 100, Actions on structures

/6/ DIN 1055:2005-03, Part 4, Wind loads

/7/ DIN 1055:2006-03, Part 4 Amendment 1, Wind loads, Amendments to DIN 1055-4:2005-03

/8/ DIN 1055:2005-07, Part 5, Snow and ice loads

/9/ DIN 18800: 1990, Part 1, Structural steelwork; design and construction

/10/ DIN 18800: 1990, Part 2, Steel structures; Stability - Buckling of bars and skeletal structures

/11/ Krüger Ulrich, Stahlbau Teil 1+ 2, Ernst & Sohn Verlag 1998

/12/ DIN EN 1993-1-1:2010, Design of timber structures – Part 1-1: General

/13/ EN 1990:2010, Basis of structural design

/14/ EN 1991-1-1:2010, Actions on structures – Part 1-1: General Actions on Structures:

/15/ EN 1991-1-3:2010, Actions on structures – Part 1-3: General actions - Snow loads

/16/ EN 1991-1-4:2010, Actions on structures – Part 1-4: General actions - Wind loads

/17/ EN 1991-1-7:2010, Actions on structures – Part 1-7: General actions - Accidental actions

/18/ DIN EN 1995-1-1/NA:2010, National Annex to EN 1995-1-1

/19/ DIN EN 1990/NA:2010, National Annex to EN 1990

/20/ DIN EN 1991-1-1/NA:2010, National Annex to EN 1991-1-1

/21/ DIN EN 1991-1-3/NA:2010, National Annex to EN 1991-1-3

/22/ DIN EN 1991-1-4/NA:2010, National Annex to EN 1991-1-4

/23/ DIN EN 1991-1-7/NA:2010, National Annex to EN 1991-1-7