Timber Truss FWH+

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.

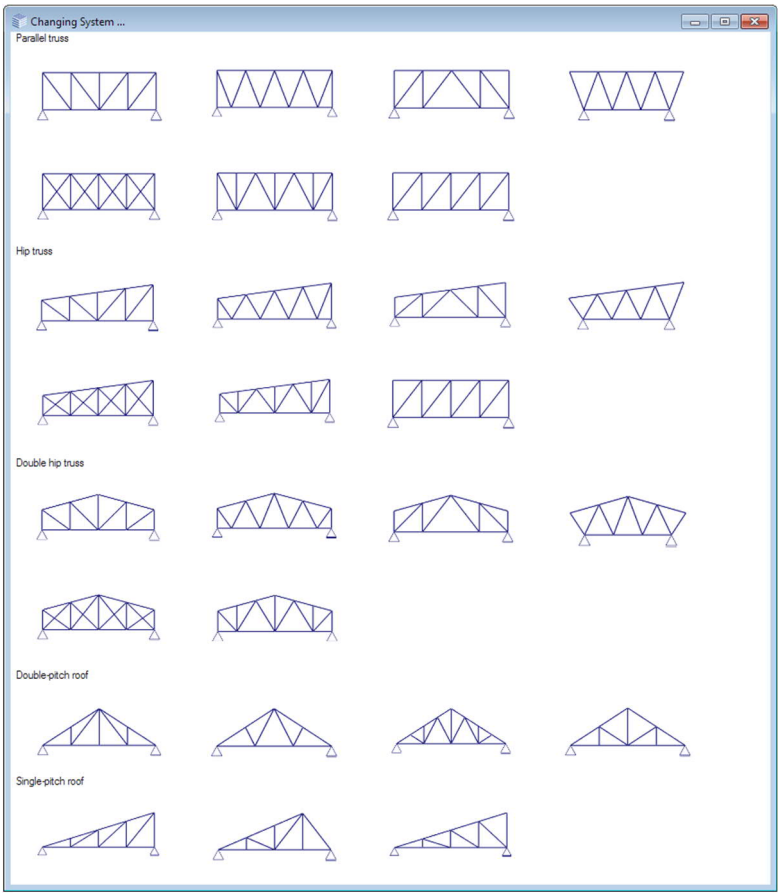
Further documents:

Wind and Snow Loads-PLUS

Application options

The software is suitable for the structural calculation and design of timber 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. Thus, the staggering of e.g. the struts is possible depending on the stress.
- Continuous chords can be considered as flexurally rigid members.
- Deflection is calculated in accordance with the strut-and-tie theory.

Available standards

Timber:

- DIN EN 1995
- ÖNORM EN 1995
- BS EN 1995
- PN EN 1995

Fire design

Verification method:

- Simplified method
- Exact method

Load transfer options

Here (▸ Design ▸ Load transfer) the characteristic support reactions can be transmitted to the programmes

- Steel column STS+
- Wooden column HO1+
- Reinforced concrete column B5+
- Reinforced concrete bracket B9+

Design in HO13+

Interface to the program Timber Joint HO13+ for the design of a selected node (steel-timber connection) with transfer of the node forces/the complete load combination and saving of the affiliation to the selected node (▸ Design ▸ Connection details).

Calculation and design

First, the individual load cases are determined in accordance with the selected truss framing system. The load case combinations are generated subsequently.

See the chapter → Generation of combinations for timber – EN 1990

The individual member forces for the different load cases are determined in accordance with the strut-and-tie theory.

The maximum internal forces are determined for the following types of members:
- Top chord
- Bottom chord
- Post
- Diagonal strut

Verifications

Tension and stability verifications.

See the chapter → Timber verifications – EN 1995

The support reactions are always determined for the simple loads.

Optionally, you can put out the loads on the supports separately for the different action groups.

Generation of combinations for timber

The combination rules are based on the probabilistic partial safety concept (as per EN 1990).

For the structural safety verifications, the combinations are generated for the permanent and transient situations. If an accidental action applies, the combinations for the accidental design situation are generated in addition.

For the serviceability verification, only the infrequent and quasi-permanent situations are relevant.

The software generates internally all combinations in accordance with the relevant rules (EN 1990) and performs all corresponding verifications. Only the combinations that turn out to be decisive in the individual verifications are put out, however.

The following standard load cases are examined by the software:

- permanent loads separately for the top chord and the bottom chord
- snow on one side, either left or right
- wind from the left, if a ridge was defined
- wind from the right, if a ridge was defined
  Wind from the right is considered as the alternative to wind from the left.

Impounding wind pressure values

To take different impounding wind pressure values for different heights above ground level into account, you can specify the height of the bottom chord above the ground level.
In this case, the software applies the different impounding wind pressure values to the different sections in accordance with the standard. See Building and Load Parameters.

Timber verifications - EN 1995

Stress-resistance/stability verifications

The stress-resistance verifications are performed as specified by para. 6.1 and 6.2.

For the shear stress analysis, the full shear force applying to the support is considered.

The stability verification is based on the equivalent bar method specified by para. 6.3.

The system lengths can be influenced through user-defined outer supports.

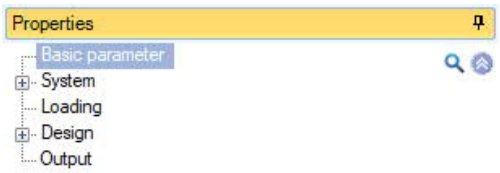
Support reactions

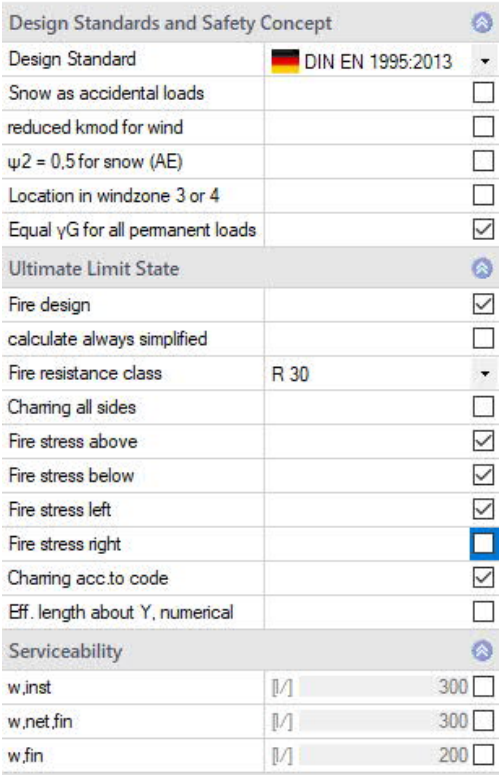
The maximum support reactions in vertical and horizontal direction are determined and output separately for load cases and actions (each as characteristic values) and as design values for the maximum combinations.

The output of the minimum support reactions is optional, however, these support reactions must NOT be used for the verification against uplift!

Data entry

You can enter values and define control parameters in the menu on the left screen section. The effect of a value that you enter is immediately shown in the graphical representation on the right screen section. Before entering any data, you can edit the dimensional units (cm, m ...) via the options File ▸ Program settings.





Wizard

The wizard is automatically launched when you start the software. You can disable the wizard in the settings menu.

Input options in the three-dimensional GUI

The data entry via the GUI is described in the document "Basic Operating Instructions - PLUS".

Basic parameters

Standard and safety concept

Selection of the standard.

Available standards - see application options.

Snow accidental/load factor snow:

Check this option if 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).

Reduced kmod with wind:

Check this option to use the modification coefficient kmod under wind action as an average value for the load duration classes ‘short’ and ‘very short’.

ψ2:

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)

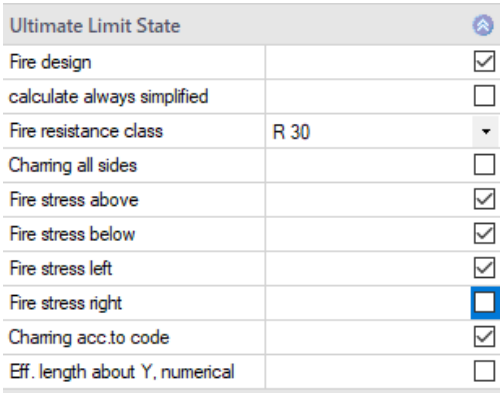
Location in wind zone 3 or 4:

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



Fire design:

Check this option to display the data-entry fields for effects of actions by fire and to perform the corresponding verification.

Verification method:

If this option is marked, the simplified method (with reduced cross-sections) is used for the calculation, otherwise the program carries out both methods (simplified and exact method) and outputs the decisive result.

Fire-resistance class:

Selection of the desired fire-resistance class or user-defined specification of the charring rate.

Charring on all sides:

Uncheck the box to select individual sites for fire exposure.

Charring rate acc. to code:

Uncheck this option to specify user-defined charring rates for each side; otherwise, the values of the standard are used.

Eff. length about Y numerical:

If the option is selected, the buckling length for buckling in the direction of the structural plane is determined numerically.

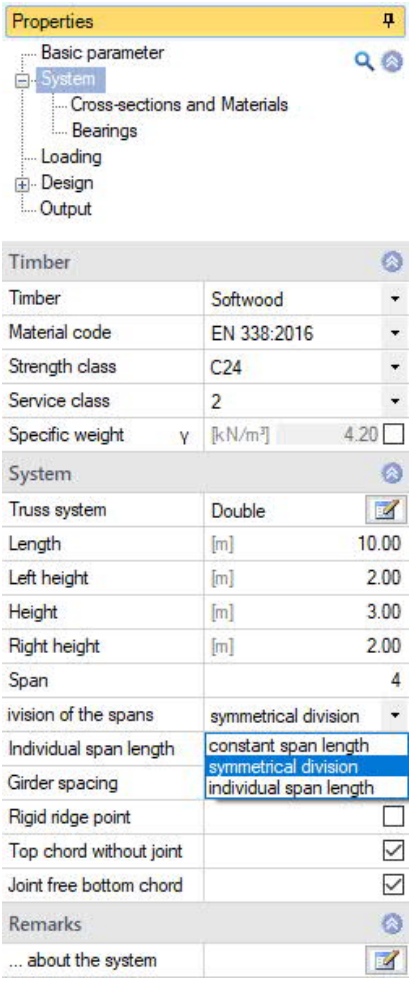
Serviceability / Deflection

w,inst	limit value of the elastic deflection of a single-span truss
w,net,fin	limit value of the summarized elastic deflection and creep deformation of a single-span truss
w,fin	limit value of the final deformation of a single-span truss

System

Timber material

Select Softwood, Hardwood or Glulam.
Material code: standards for softwood, hardwood, glulam; additional parameters, such as the strength class, the servive class etc.



Truss system

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

See also: graphical representation of the type of truss 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 tooltip.

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.

Top/Bottom chord without joint

If this option is checked, support moments are generated in the top/bottom chords above/below the connections.

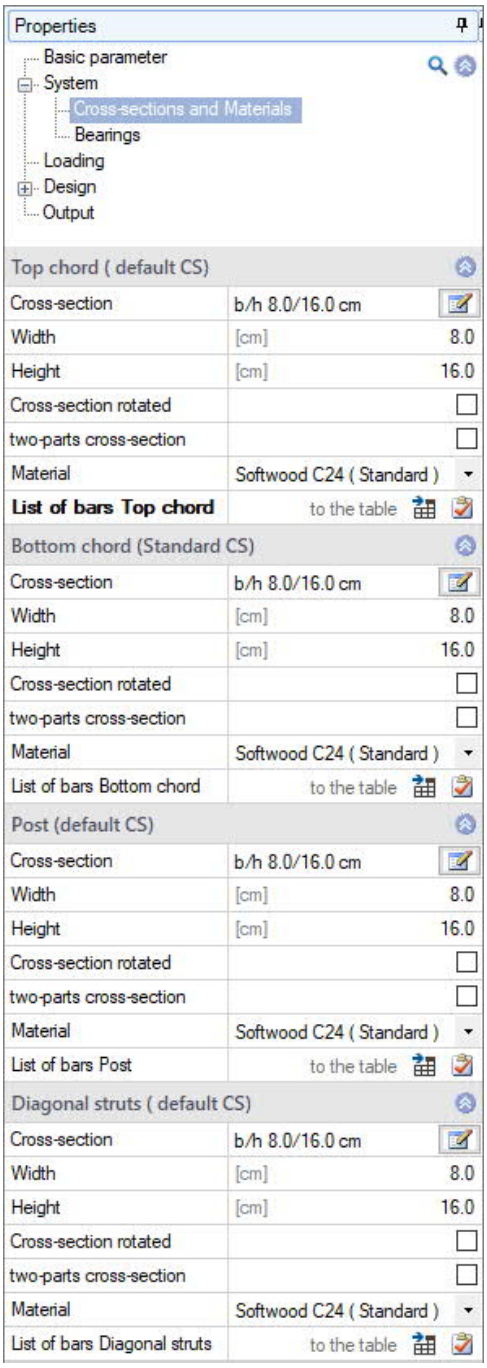
Remarks

Call up the remark editor. The remarks on the system are then listed in the output document in the corresponding section.

Cross-sections

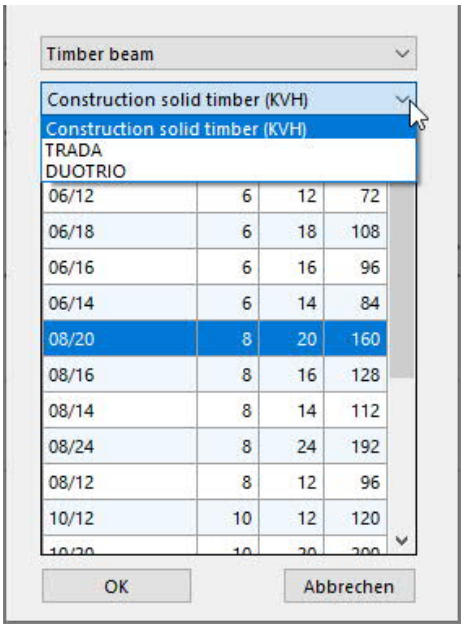
Cross-sections and material can be defined differently for chords, posts or diagonals. The values can be entered here directly via the dimensions (width/height) or by selecting a cross-section via the button.

You can obtain a clear representation from the tables in the "List of bars" (Tab "List of bars" below the graphic).



Selection of the cross-section

Choose the type of timber (KVH = solid construction timber, TRADA, DUOTRIO) and the cross-section.

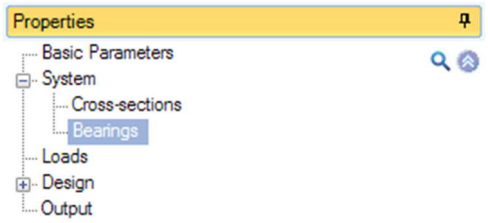


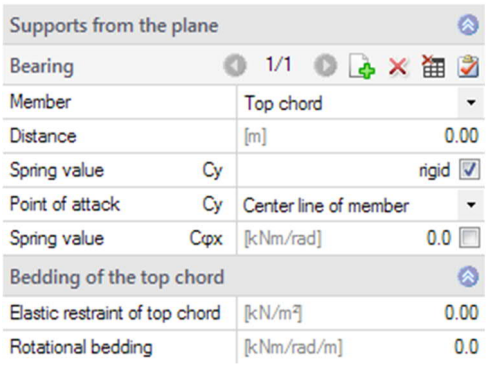
Cross-section rotaded — check this option to rotate the cross section by 90°.

Two-parts cross-section — check this option to define a single-piece or two-piece cross-section.

Supports

Supports ...





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

Tip:	*You can also add/remove/edit a support directly in the graphic via the context menu.*
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 the rotation around the component x-axis

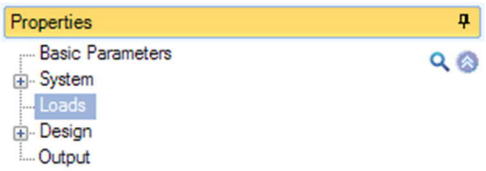
Continuous support of the top chord

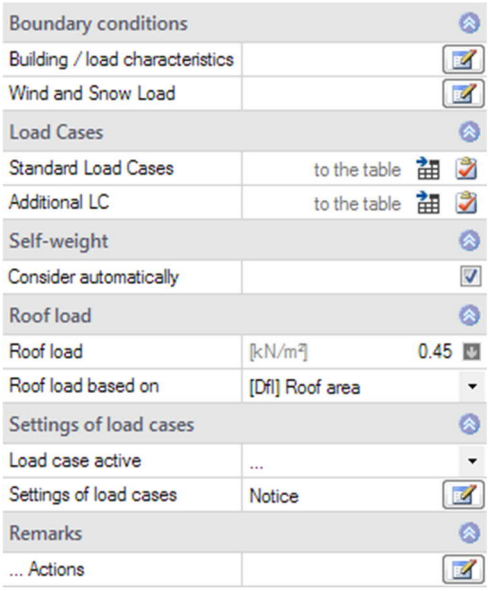
Elastic restraint of top chord	translational bedding at the top edge of the top chord in the y-direction
Rotational bedding	torsional bedding of the top chord about the x-axis

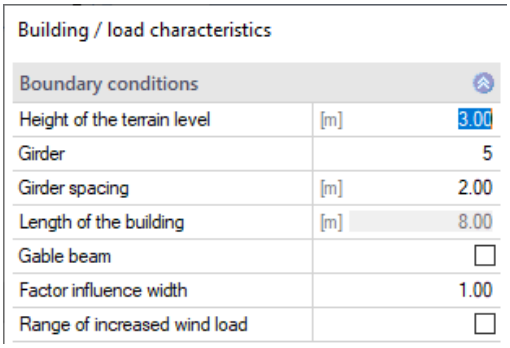
Loading

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.

Girder

Number of trusses in the building (at least three).

Girder 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 beam

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.

Factor influence width

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

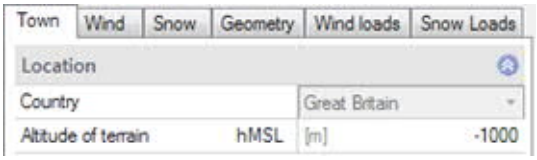
Range of increased wind load

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.

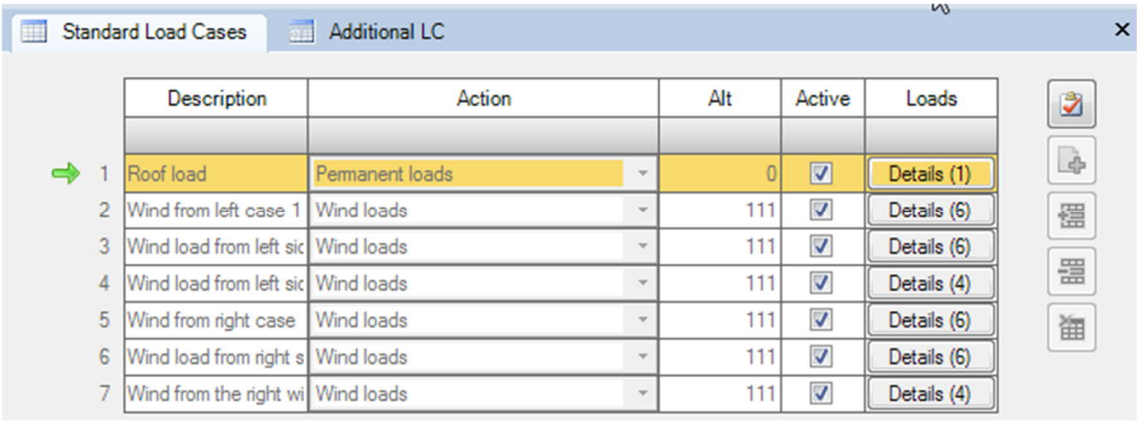
The different tabs (municipality, wind, snow...) provide access the respective dialogs and data-entry fields.



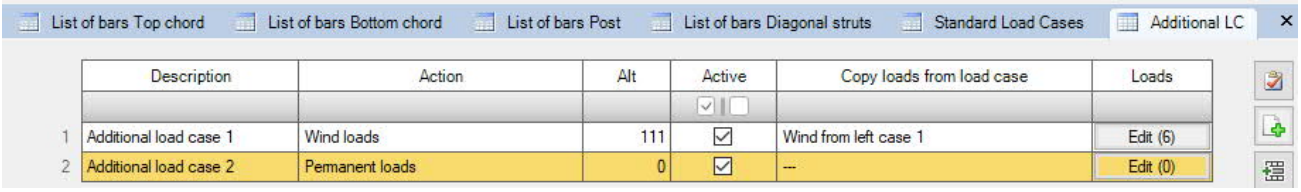
Standard load cases and additional load cases

The "Standard load cases" and "Additional load cases" tabs allow you to display the associated load case tables. You can edit and enable or disable individual load cases or display the details.

The term "standard load cases" refers to all load cases in compliance with the standards that are generated automatically by the software.



In the "Additional load cases" table, you can enter additional user-defined load cases.



Click to the "+" button to add a new row.

Description: You can specify an individual name for the load case.

Action: the appropriate actions can be selected from a list: Permanent loads ... Seismic.
You can also create user defined actions and select them here.

Alt. Alternative group,
Different variable load cases with similar actions can be combined to an alternative load case group by assigning an alternative group number to them. Only the decisive load case of this alternative load case group is invoked in the superposition.

Active you can enable (tick checkbox) or disable (untick checkbox) individual load cases. Disabled load cases are not considered.

Copy loads of load case
The option allows you to copy the loads of a standard load case. You can customize the loads via the "Edit" button. The "arrow symbol" can be used to call up a load value compilation - see description in the LAST+ programme.

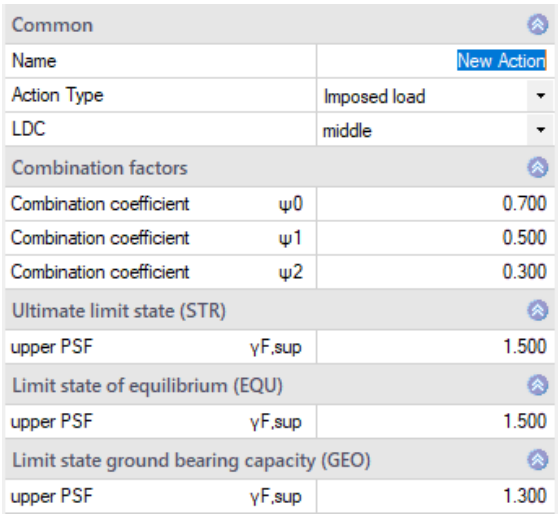
Additional load parameters

Self-weight

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

User defined actions

Here you call up a dialog for entering user-defined actions. Via the button "Add action" you can assign a name and adjust the default parameters. Furthermore, these actions can also be exported/imported in order to use them in another item.



Roof load

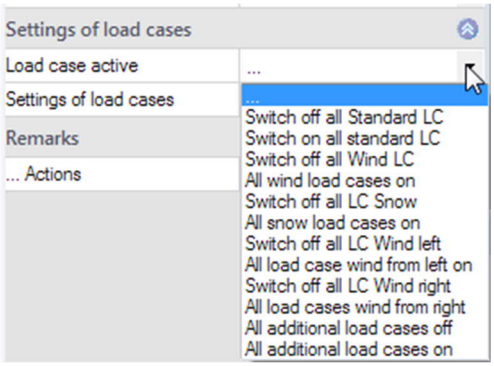
Enter the permanent load of the roof superstructure. :Load value compilation.

The load of the roof superstructure can optionally be referenced either to the roof area or to the base area.

Load case settings

You can control the different load cases by selecting them from the displayed list.

Click on the information button to learn more about this feature.



Remarks

Call up the remarks editor. The remarks on the actions are then listed in the output document in the corresponding section.

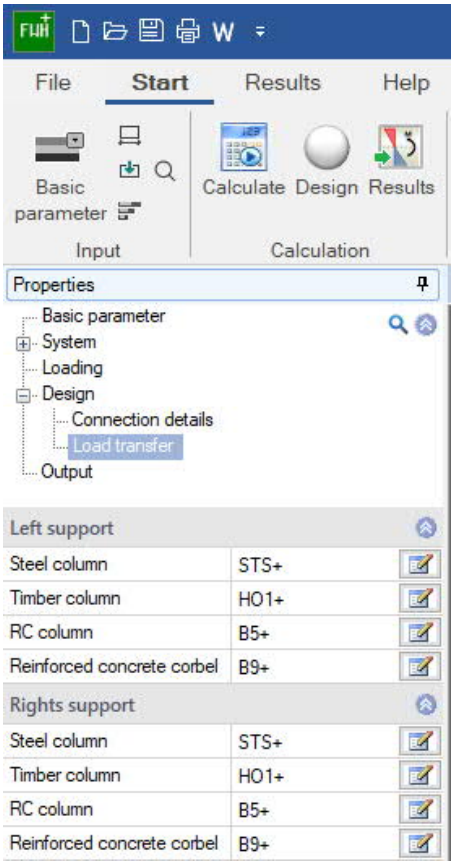
Design

Calculate

Click on the "Calculate" button. After completion of the calculation, the utilizations are represented.

Remarks

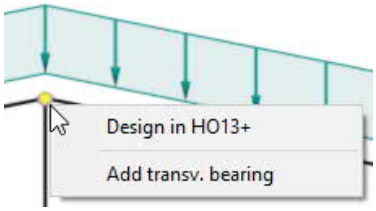
Call up the remarks editor. The remarks on the results are then listed in the output document in the corresponding section.



Connection details

Calling the program Timber Joint HO13+ with transfer of the node forces.

To do this, click on the button  . In a dialogue box you can now select the node to be transferred to HO13+.



You can also click with the right mouse button directly on a node in the graphic and then on "Design in HO13+".

Load transfer

You can transfer the characteristic support reactions to the applications:

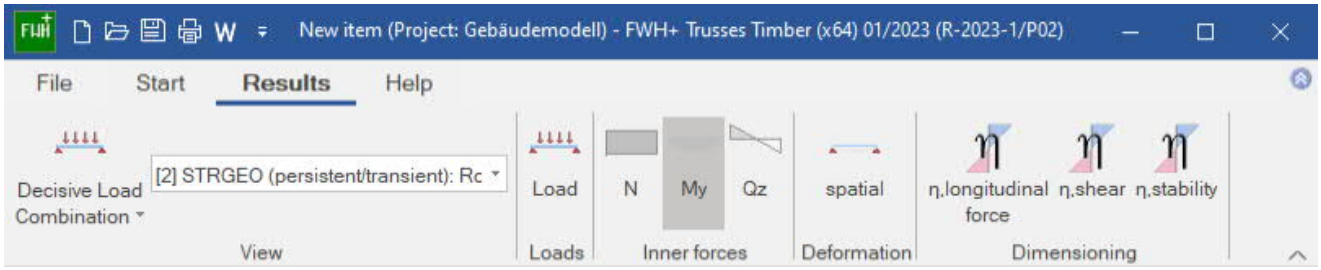
- Steel Column STS+
- Timber Column HO1+
- Reinforced Concrete Column B5+
- Reinforced Concrete Corbel B9+

Interfaces / Connected programmes

Via the Connected programs icon, you can pass the system on to the RSX program or the FWS+ Trusses Steel for further processing.

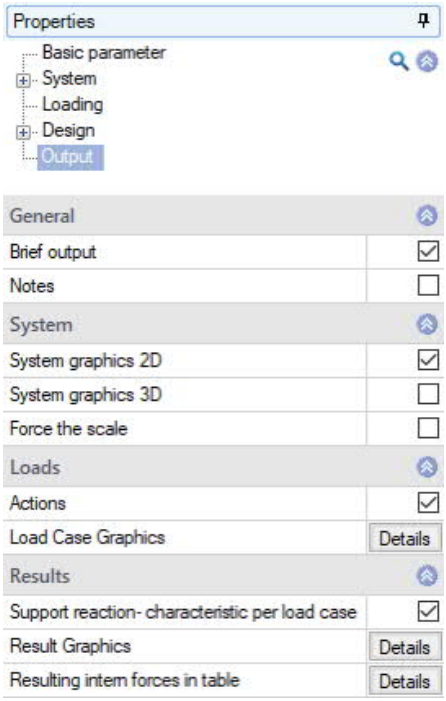
Results and output

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. For additional contents such as design details, coefficients etc, deselect the ‘Brief output’ option.



The following results are shown in the form of tables in addition to the system and the load data:

- Maximum values of the vertical and horizontal support reactions (characteristic) and the associated load case combination.
- The maximum deflections of the load-bearing structure as well as the associated load case combination and the utilisation referenced to the specified maximum deflection, if applicable.
- The design of the individual components ‘top chord’, ‘bottom chord’, ‘posts’ and ‘diagonal struts’ with the most important design values of the required verifications for the decisive load case combinations in each case.

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.

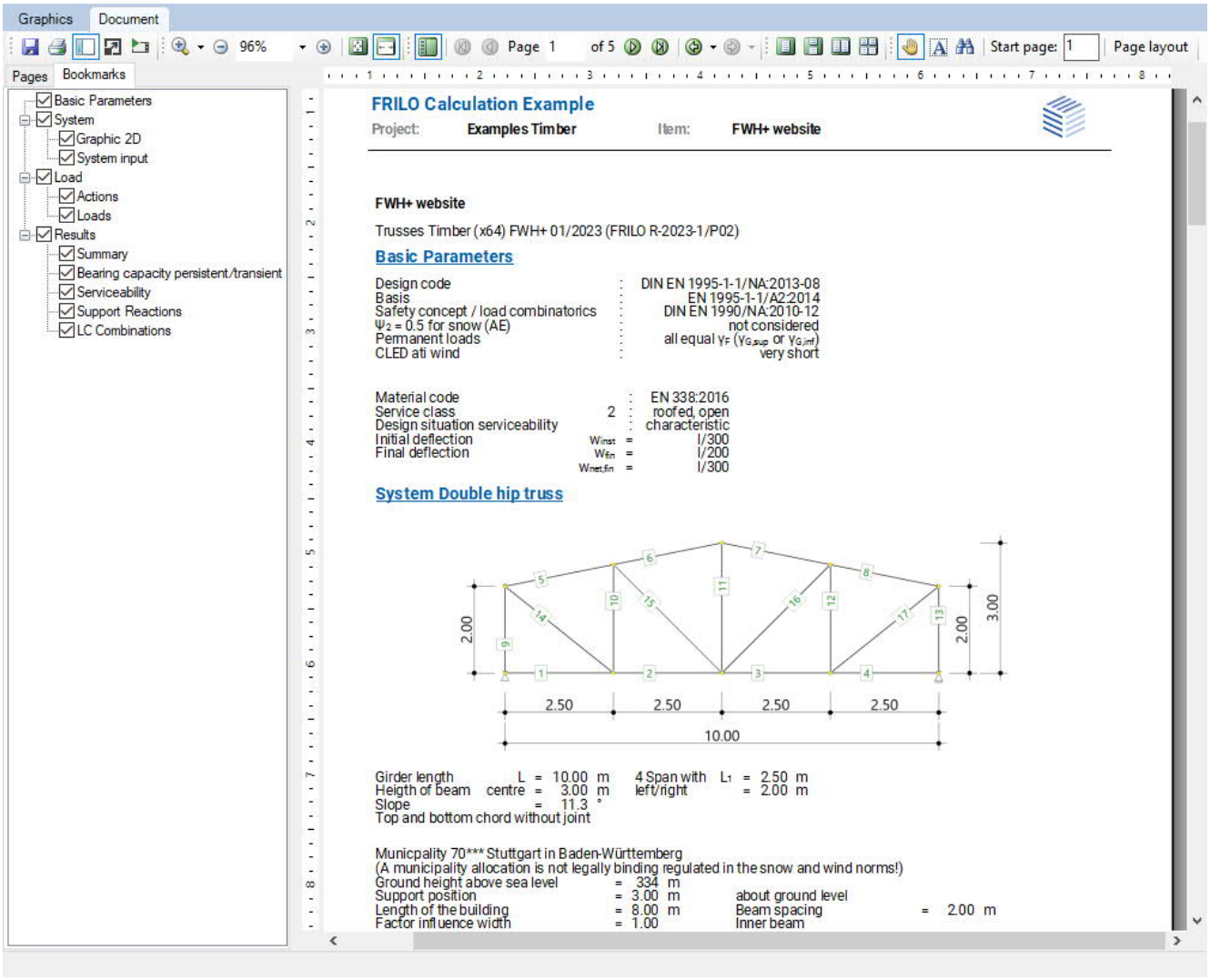


Fig.: The output document can be displayed via the 'Document' tab.

Reference literature

/1/ EN 1995-1-1:2010, Design of timber structures –Part 1-1: General

/2/ EN 1990:2010, Basis of structural design

/3/ EN 1991-1-1:2010, Actions on structures – Part 1-1: General Actions on Structures:

/4/ EN 1991-1-3:2010, Actions on structures – Part 1-3: General actions - Snow loads

/5/ EN 1991-1-4:2010, Actions on structures – Part 1-4: General actions - Wind loads

/6/ EN 1991-1-7:2010, Actions on structures – Part 1-7: General actions - Accidental actions

/7/ DIN EN 1995-1-1/NA:2013, National Annex to EN 1995-1-1

/8/ DIN EN 1990/NA:2010, National Annex to EN 1990

/9/ DIN EN 1991-1-1/NA:2010, National Annex to EN 1991-1-1

/10/ DIN EN 1991-1-3/NA:2010, National Annex to EN 1991-1-3

/11/ DIN EN 1991-1-4/NA:2010, National Annex to EN 1991-1-4

/12/ DIN EN 1991-1-7/NA:2010, National Annex to EN 1991-1-7