FRILO Software
A NEMETSCHEK COMPANY

D12 – Collar Beam Roof

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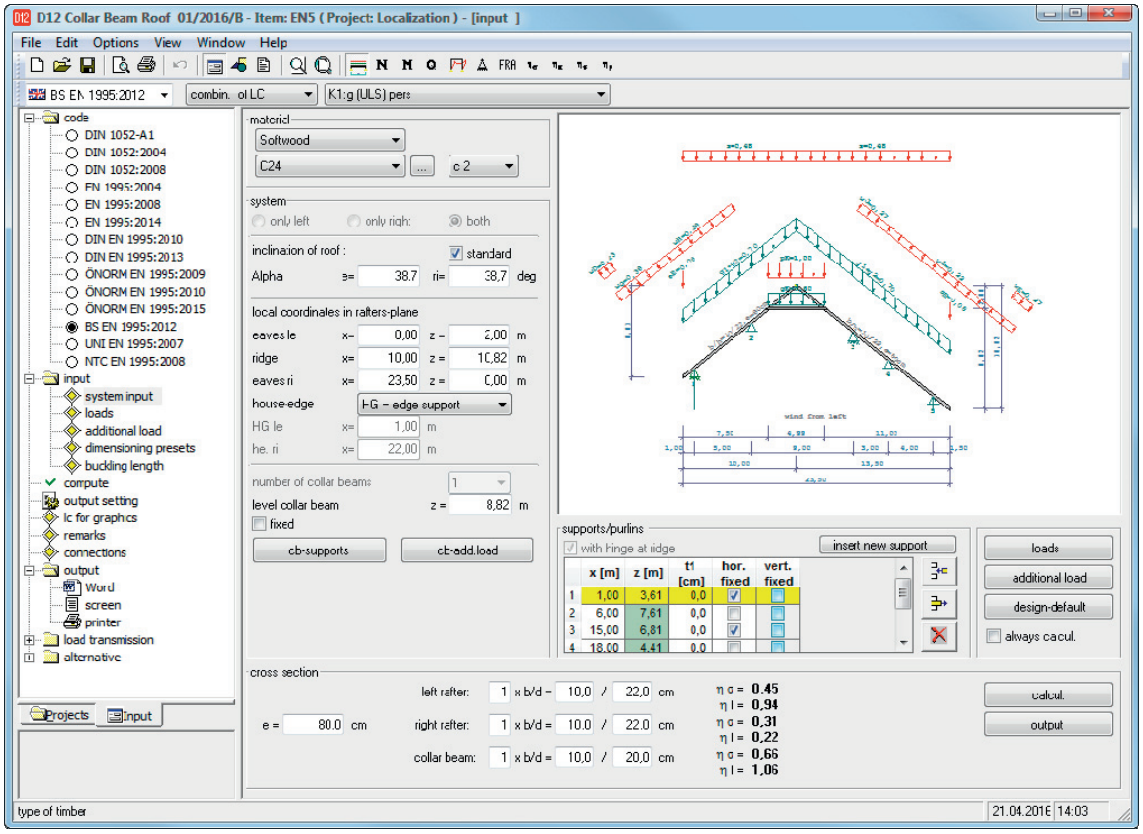
As of 21/04/2016



D12 – Collar Beam Roof

Note: *This document describes the **Eurocode-specific application**. Documents containing old standards are available in our documentation archive at www.frilo.de >> Dokumentation >>Manuals>Archive.*

Contents

Further information and descriptions are available in the relevant documentations:

FDC – Basic Operating Instructions	General instructions for the manipulation of the user interface
FDC – Menu items	General description of the typical menu items of Frilo software applications
FDC – Output and printing	Output and printing
FDC - Import and export	Interfaces to other applications (ASCII, RTF, DXF …)
FCC	Frilo.Control.Center - the easy-to-use administration module for projects and items
FDD	Frilo.Document.Designer - document management based on PDF
Frilo.System.Next	Installation, configuration, network, database

Application options

The D12 application allows the calculation of conventional collar beam roofs with sway/non-sway collar beams as well as rafter roofs.

Available standards

- EN 1995-1-1:2004/2008/2014
- DIN EN 1995-1-1:2010/2013
- ÖNORM EN 1995-1-1:2009/2010/2015
- BS EN 1995-1-1:2012
- UNI EN 1995-1/NTC

still optionally available:

- *DIN 1052:2004/2008*

In addition to typical roof loads such as uniformly distributed, weight, snow and wind loads, additional loads can be defined as uniform linear loads, concentrated or trapezoidal loads and assigned to groups of action. The software also allows you taking wind uplift at overhangs into account.

The load assumptions can optionally be based on EN 1991-1-x in combination with the relevant National Annexes - *still available: DIN 1055*.

If EN 1995 or EN 1991 was selected, combinatorics is based on EN 1990.

DIN 1052: combinatorics IAW DIN 1055-100

The standard applicable to the assumption of wind and snow loads is freely selectable.

The supporting forces are no longer put out as the result of the superposition but separately for each group of actions. The ridge joint and ledger connection forces are specified in addition.

The support reactions and connection forces are optionally put out either as characteristic values of the individual actions or as design values of the maximum and minimum combinations.

The verification of the resistance against wind suction is optionally available.

With non-sway collar beam roofs, the bracing of the valley plate is not verified.

Basis of calculation

The calculation is based on the strut-and-tie model. Axial force deformations and the effect of the real, specified support reactions are taken into account.

In contrast to sway collar beam roofs, virtual, horizontally retained supports are assumed at the collar beam connections of non-sway roofs.

The bearing forces are exactly determined in the framework calculation. Due to constraints caused by axial force effects, horizontal bearing components might occur even if only vertical external loading applies.

EN 1995-1

EN 1995-1-1 is the basic framework for the European timber standard. In combination with EN 1995, always a National Annex must be used, which specifies the nationally determined parameters. This applies also to EN 1990 and EN 1991. Moreover, National Annexes may have an influence on verification methods prescribed by the Eurocode. You can always select the National Annex in the software.

For the verifications as per EN 1995-1-1, the superpositions are always created in accordance with the rules of EN 1990-1. The support reactions are optionally represented as characteristic values of the groups of actions or as design values for the maximum and minimum combinations. The splitting into characteristic values is helpful to generate additional combinations for the connected components.

The stress and stability verifications are based on EN 1995-1-1, 6.2 and 6.3. The shear resistance verification takes always the entire shear force into account.

Determination of the effective length – see the document "Roof load design".

The serviceability verifications are based on EN 1995-1-1, 7.2. The vibration resistance verification as per 7.3 is currently not available for roofs.

EN 1990, EN 1991

The software can determine the values for wind and snow loads on the basis of the National Annexes to EN 1991.

The combination rules are specified by EN 1990.

Since all standards and National Annexes are based on the semi-probalistic safety concept, the software allows combinations of different standards. We strongly recommend using the associated National Annexes, however.

Definition of the structural system

In the "Material" section, you can define the timber species, and the grading and usage classes.

For fasteners, steel St37 is assumed.

Activating the ... button displays a dialog for the definition of additional material-specific details (specific weight).

You can display the available definition options via the menu item ▸ Options ▸ Settings:

- Spanwise definition (D9)
- Definition via coordinates (D11/D12)
- Projection-related definition (D11/D12)

This dialog also allows you to define which standard should be set by default when starting the software.

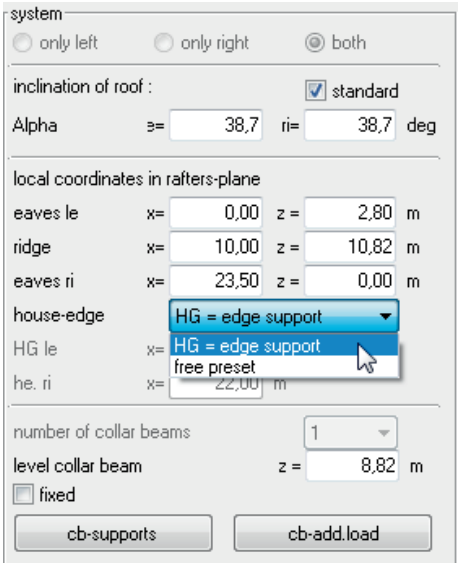
Collar beam

The definition of collar beams located outside of the structural system is not allowed. In this case, the ordinate of the collar beam in question is reset to the ordinate of the ridge. Collar beams having the same ordinate as the ridge are treated in the software as if they would not exist.

No. of collar beams	number of existing collar beams. Currently, you can only define a single collar beam!
level collar beam	height ordinate of the collar beam (distance to the ridge in z-direction).
cb-support	accesses a dialog for the definition of supports for collar beams.
cb-add load	accesses a dialog for the definition of additional loads for collar beams.
fixed	allows you to define whether the collar beam roof is sway or non-sway (non-sway if the option is checked).

Definition via coordinates

System



Options only enabled in D11:

only left	checking this option makes sure that only the rafter system on the left roof side is processed.
only right	only the rafter system on the right roof side is processed.
Both sides	the rafter systems on both sides are processed simultaneously.

Roof inclination

Via the option "standard" you can specify a rafter inclination angle that is set as the standard:
Alpha left: left rafter
Alpha right: right rafter
Please note that the ridge point is always considered as a fixed point when you check this options. The coordinates of the eaves are adjusted accordingly.
Note: A displacement of the ridge point always leads to a displacement of the entire system.

Coordinates in the rafters' plane

Specify the coordinates of the extreme values of the rafters here. You can also specify negative values.

The inclination of the rafters is calculated from these coordinates, if the option "Pre-set" has not been checked.

x left eaves x-coordinate of the front end of the left rafter (eaves)

x ridge x-coordinate of the ridge point

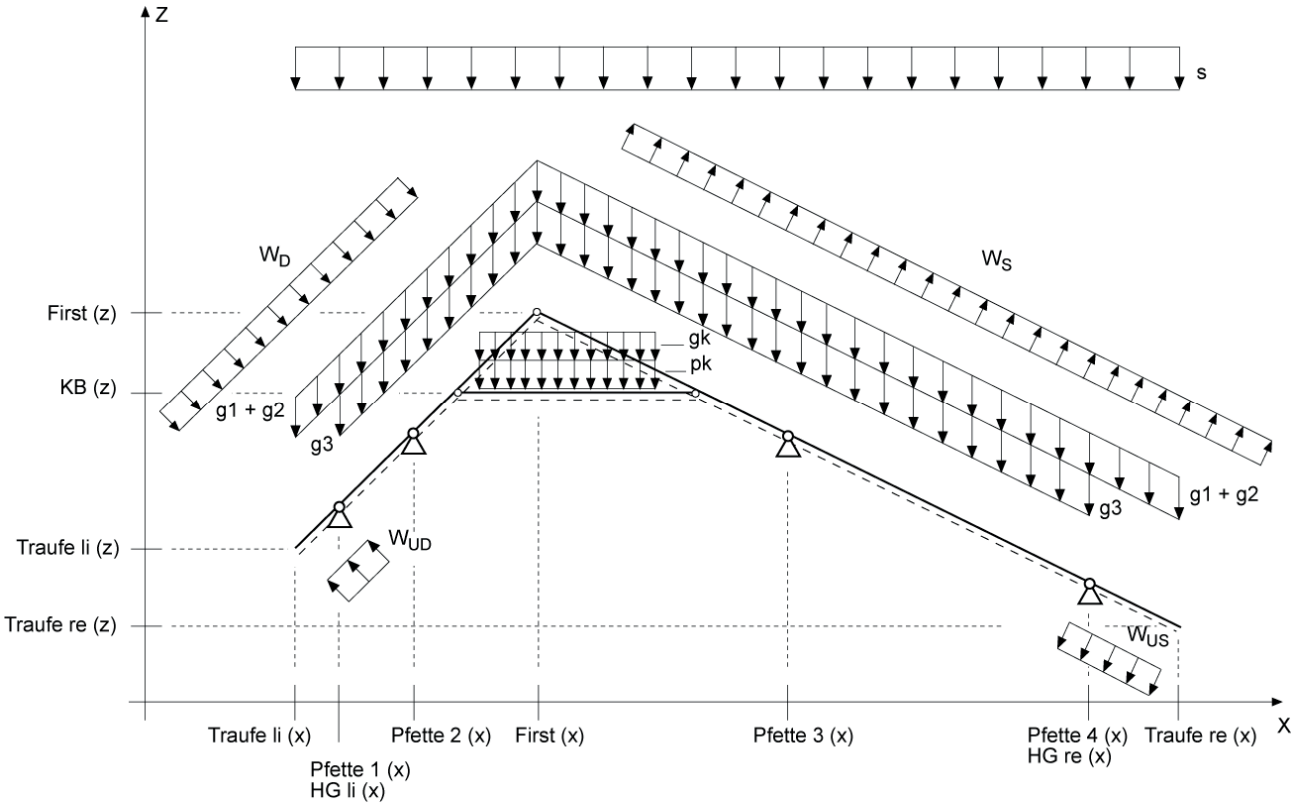
x right eaves x-coordinate of the rear end of the right rafter (eaves)

z the height ordinates of the individual rafter points assigned to the x-coordinates.

Bldg. floor plan BFP = edge support: the edges of the building floor plan coincide with the edge supports; the roof overhang corresponds to the cantilever.
Free specification: definition of a freely selectable roof overhang.
The overhang is particularly important for the definition of wind uplift and the consideration of finishing loads.

BFP left coordinate of the left edge of the building floor plan.
Roof overhang = distance from the front edge of the rafter to the left edge of the building floor plan.

BFP right coordinate of the right edge of the building floor plan.
Roof overhang = distance from the front edge of the rafter to the right edge of the building floor plan.

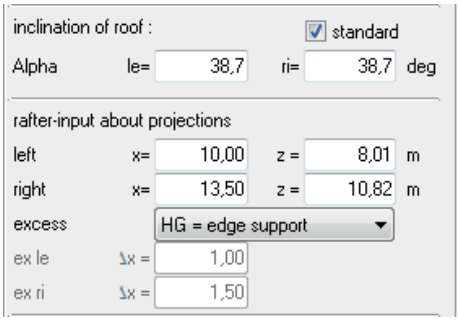


Ill.: Dimensions in D12

Projection-related definition

The definition of the structural system via this option is done by specifying the projection lengths in the x- and z- directions.

Roof inclination



As described in the chapter Definition via coordinates, you can set a user-defined inclination angle for the rafters as a default by checking this option:

Definition of the rafters via projections

If you have checked the option "Pre-set roof inclination", the corresponding projection lengths are adjusted to the specified inclinations.

x left projection length of the left rafter in the x-direction

z left projection length of the left rafter in the z-direction

x right projection length of the right rafter in the x-direction

z right projection length of the right rafter in the z-direction

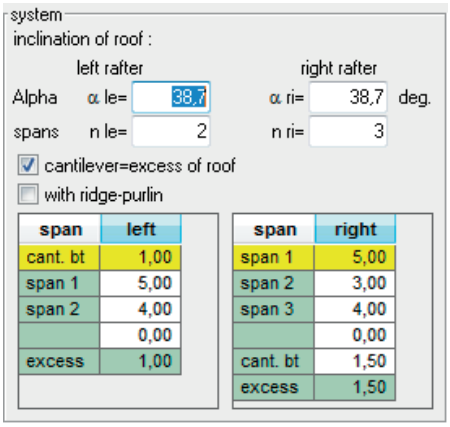
Overhang BFP = edge support: The edges of the building floor plan coincide with the edge supports; the roof overhang corresponds to the cantilever.
Free specification: definition of a freely selectable roof overhang.
The overhang is particularly important for the definition of wind uplift and the consideration of finishing loads.

Cantil. left Δx projection length of the left roof overhang in the x-direction
Roof projection = distance of the eaves point to the left edge of the building floor plan.

Cantil right Δx projection length of the right roof overhang in the x-direction.
Roof projection = distance of the eaves point to the right edge of the building floor plan.

Spanwise definition

When selecting this option, you can define the structural system to be calculated span by span. First, you must define the inclination of the rafters on both sides and the number of spans. Subsequently, you can define the projections lengths of the individual spans and cantilevers in the x-direction.



Roof inclination

α left specification of the inclination angle of the left rafter.

α right specification of the inclination angle of the right rafter.

n left number of spans for the left rafter.

n right number of spans for the right rafter.

Cantilever=roof overhang

Option for the definition of a roof overhang. If you uncheck this option, you can make a user-defined specification that differs from the cantilever length. The overhang is particularly important for the definition of wind uplift and the consideration of finishing loads.

With ridge purlin if you check this option, a ridge purlin is included.

Cantil. bottom projection length of the cantilever at the eaves in the x-direction

Span i projection length of the span number "i" in the x-direction.
Unlike a cantilever, a span always has a support at its front end and its rear end!

Overh. Projection lengths in the x-direction of the roof overhang.

Supports/purlins

The definition of supports depends on the selected definition mode (coordinates, projection-related, spanwise)

Definition via coordinates

The supports are defined by entering their coordinates. Place the supports by specifying their x-coordinate. You can check the height level with the help of the indicated z-ordinate. You cannot position the supports by defining the ordinate because it cannot be assigned unambiguously.

x x-coordinate of the supporting point in the default system of coordinates [m]. The associated height ordinate z is determined automatically.

z displays the height ordinate z of the supporting point in the default system of coordinates [m].

Projection-related definition

The supports are defined by entering their distance to the rafter front end on the left. You cannot position the supports by defining the ordinate because it cannot be assigned unambiguously.

Dist. distance of the support from the rafter front end on the left in [m].

Spanwise definition

You need not define supports separately in this case, because their location is already defined via the spans. You must only define the type of support.

No. consecutive support number.

t birdsmouth or cutting depth [cm], → it weakens the rafter cross section in the supporting area.

Hor. fixed check this option to define the corresponding support as horizontally non-sway.

Vert. fixed check this option to define the corresponding support as vertically non-sway.

Collar beam support

Click on the cb-supports button to access the definition dialog.

Input fields for the coordinates/projection-related definition:

	Nr.	xA [m]	xE [m]	x [m]	hor. fest	vert. fest
1	1	5,91	14,09	5,91	☐	☑

No. no. of the collar beam that is supported. Currently, you can define two supports maximum.

xF displays the x-coordinate of the front end of the selected collar beam in the default system of coordinates [m].

xR displays the x-coordinate of the rear end of the selected collar beam in the default system of coordinates [m].

x x-coordinate of the supporting point in the default system of coordinates [m]. The associated height ordinate z is determined automatically.

Hor. fixed check this option to define the corresponding support as horizontally non-sway.

Vert. fixed check this option to define the corresponding support as vertically non-sway.

Input fields for the spanwise definition

supports collar beam

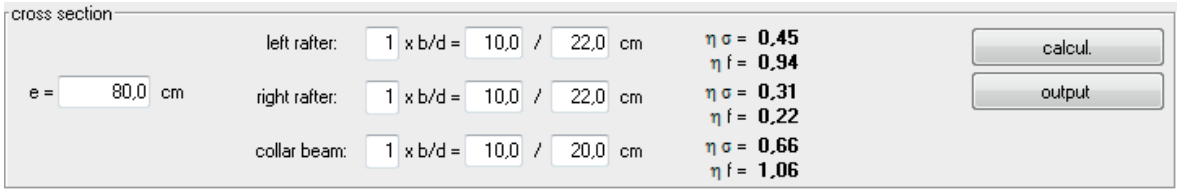
	No.	L [m]	dist [m]	hor. fixed	vert. fixed
1	1	8,19	0,00	☐	☑
*	0			☐	☐

L displays the length of the selected collar beam

Dist. distance of the support to the front end of the collar beam

Cross section

e	rafter spacing [cm]
Left rafter	n · x · b/d: number of cross sections, width/height of the individual cross section.
Right rafter	n · x · b/d: number of cross sections, width/height of the individual cross section.
Collar beam	n · x · b/d: number of cross sections, width/height of the individual cross section.
ησ	Eta Sigma: max. utilization ratio of the cross section by stresses.
ηf	Eta f: max. utilization ratio of the cross section by deflection.



Interactive cross section design

The check values Eta Sigma and Eta f indicate the maximum utilization ratios for stress and deflection and are displayed to allow the user evaluating the cross section.

The stress resistance verifications are performed for the maximum span loading and the maximum column loading.

The option "Always recalculate" must be active for an interactive cross section design. To change the cross section (b/d) of the rafter or ledger, proceed as follows:

- Position the cursor in the respective input field (b or d).
- Edit and adjust the indicated values with the help of the arrow keys (↑↓) of your keyboard.

Check Eta Sigma and/or Eta f.

Loads

Selection of the standard

The selected standard is only relevant for the determination of the load values. Combinatorics is based on the safety concept specified by the selected timber standard.

The following permanent loads can be applied:

g1 loads by the roof covering

g2 loads by the structure

g3 loads by the roof finishing

The loads "g1" and "g2" act over the entire rafter length. Their load ordinates are referenced to the roof area.
The finishing load "g3" applies from the edges of the building floor plan to the ridge and/or between the edges of the building floor plan.

The self-weight and snow loads apply vertically, the wind loads apply as wind pressure or wind suction orthogonally to the roof area.

For collar beams, you can define permanent loads "gk" as well as live loads "pk". The live loads are applied to one side only in the asymmetrical load cases.

Loading and design documentation

Further information on the topics

- load assumptions
- wind and snow loads
- superpositions
- additional loads
- design settings
- effective length for buckling and lateral buckling
- load transfer
- verification of the wind suction resistance

are summarized for the D9, D11 and D12 applications in the document: Roof: Loads - Design

Output

Output of the system data, results and graphical representations on the screen or printer.

The Output item in the main menu allows you to start the output on a printer or the screen.

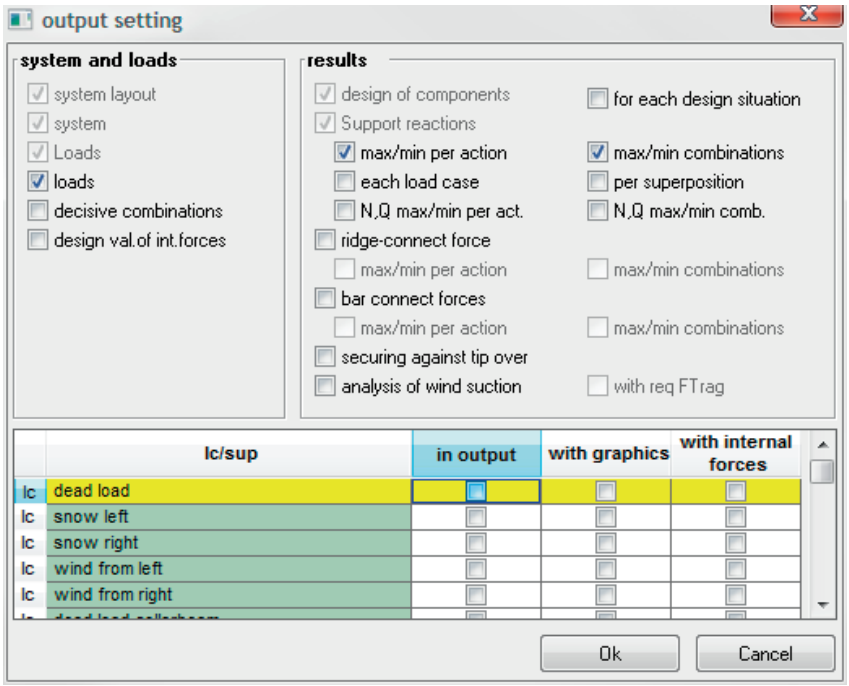
Screen	displays the values in a text window on the screen
Print	starts the output on the printer
Word	if installed on your computer, the text editor MS Word is launched and the output data are transferred. You can edit the data in Word as required.

See also the document "Output and Printing".

Note: *The "Comments" menu item allows you to integrate explanatory notes into the documents to be put out.*

Output profile

You can select supplementing information related to the load cases and the superpositions, which should be integrated in the graphical or textual output, in order to allow a more detailed evaluation of the results.

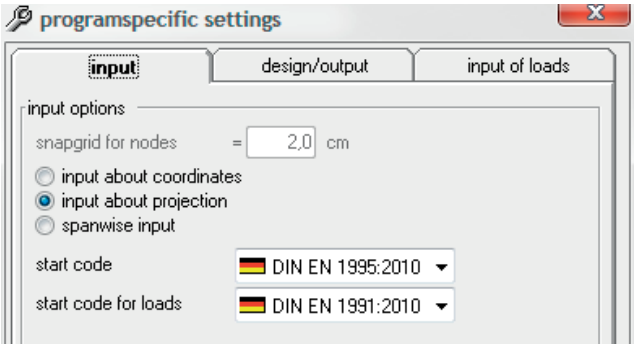


System graph	graphical representation of the structural system including the loads.
System	output of the system values in the form of tables.
Loads	output of standard and additional loads in the form of tables.
Actions	optional; the groups of actions are put out with their combination coefficients in the form of tables.
Decisive combinations	optional; the decisive combinations are put out in the form of tables.

Internal design forces	optional; the decisive internal forces in the decisive combinations are put out separately for each component in the form of tables.
Design of components	the design results for the individual components are put out in the form of tables.
Support reactions	the support reactions are put out in one of the following optionally selectable variants:
Max./min. per AG	optional; the characteristic (simple) values of the support reactions are put out separately for each applying action. The results can be used for further combinations in the subsequent components.
Max./min. combinations	optional; the maximum and minimum design values of the support reactions are put out for the combinations. A combination with other loads in the subsequent components is difficult and can only be done by approximation.
Per load case	optional; all simple support reactions are put out for each load case in the form of tables.
Per superposition	optional; all support reactions are put out for each listed superposition as design values in the form of tables.
N,Q max./min. per AG	optional; the characteristic values of the support reactions in the direction of the rafter axis and perpendicular to it are put out (analogously to the internal forces).
N,Q max./min. comb	optional; the maximum and minimum design values of the support reactions in the rafter axis are put out for the combinations. A combination with other loads in the subsequent components is difficult and can only be done by approximation.
Ridge joint forces	optional; the ridge joint forces can be put out in the following, optionally selectable variants:
Max./min. per AG	optional; the ridge joint forces are put out as characteristic (simple) values separately for each action in the form of tables.
Max./min. combinations	optional; the maximum and minimum design values of the combinations are put out in the form of tables.
Ledger connection forces	optional; the ledger connection forces can be put out in the following, optionally selectable variants:
Max./min. per AG	optional; the ledger connection forces are put out as characteristic (simple) values separately for each action in the form of tables.
Max./min. combinations	optional; the maximum and minimum design values of the combinations are put out in the form of tables.
Lateral buckling stability	optional; the results of the lateral buckling stability verification are put out.
Suction resistance verification	optional; the results of the verification of the resistance to wind suction forces are put out in the form of tables. Currently only available in combination with the old DIN 1055 standard.
With req. FTrag	optional; the force F_{Trag} that must be borne by the fasteners in the suction resistance verification is put out in the form of tables. Currently only available if the old DIN 1055 was selected.

Options - settings

The menu item ▸ Options ▸ Settings allows you to make software-specific settings.



Definition options

Capturing range	this value specifies the range in which the system combines several nodes to a single one automatically. This option helps to avoid the generation of small members in the total structural system. You should not set this value to 0 because it is important to consider a tolerance range particularly for the supports at the collar beam connections due to numerical differences.
.... input	allows selecting the definition method in the D11 and D12 applications: Via coordinates, Projection-related, or Spanwise are the available options. You can change the method any time during the session.
Default standard	allows you to define the standard that should be set by default when starting the software.

Design and output

Design IAW DIN	this option is only available in combination with the old DIN 1052:1988 standard - see documentation in our archive at www.frilo.com.
Self-weight	if you check this option, the software determines the self-weight of the components automatically from their geometry and the specific weight of their materials.
Creep in stability	check this option to consider the influence of creep in the stability verifications of components mainly under pressure in accordance with the requirements of the selected standard.
Consequence classes	CC1 to CC3 - see EN 1999, Annex B.

Definition of the loads

Pre-set w0, s0	you can optionally pre-set user-defined values for the regular snow load and the impounding wind pressure.
Snow-load-on-eaves factor	some regional building codes allow the reduction of the snow load on eaves using a particular factor.
Pre-set snow AG	this option allows you to define the snow action group to which the standard snow load should be assigned.