

# Design of roofs Dach+

This manual describes the DGK+, DKD+, DPD+, DSP+ programs together.

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## Basic Documentation – Overview

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

Further documents: <u>Roof-Loads-Design</u> <u>Fire protection analysis timber</u> <u>Wind and snowloads PLUS</u>



## Application options

The following roof types can be calculated with the programs of the Roof+ series:

#### DGK+ Hip-/Valley Rafter

Verification of single-span and multi-span hip rafters or valley rafters with freely selectable angles for the floor plan and the roof pitches of the main and secondary roofs. Roof projections are possible.

#### DKD+ Collar Beam Roof

Calculation of collar beam roofs with sway or non-sway collar beams. The collar beam can consist of one or two parts. Asymmetrical structural systems are possible.

#### DPD+ Purlin-/Rafter Roof

The program DPD+ can be used to calculate purlin roofs and rafter roofs as well as mixed roofs of both types such as purlin roofs with ridge joints, braced purlin roof, duopitched canopy roof rafter. The purlins on the left and right roof sides are designed as continuous beams under bending stress. Asymmetrical structural systems are possible.

#### DSP+ Continuous Rafter

The DSP+ program can be used to calculate and design single-span and multi-span rafters as individual components. For the continuous rafter, the wind load assumptions are based on a closed, symmetrical building and for the single-pitch roof rafter/monopitched canopy roof rafter, they are based on a closed building with a single-pitch roof. Cantilevers can be defined at the ridge and the eaves.

The roof or rafter type is selected from a selection list in the <u>Wizard</u> right at the start of the program.

Wizard	Templates	Open						
Common		Ē						
Roof / Rafter type	Purlin Roof	-						
Selection of town -	Purlin Roof							
Dead Load (Roofing) g1	Rafter Roof Braced purlin roof	- 11						
Ground Snow Load sk	Duopitched canopy roof rafter							
Wind pressure qp,0	[kN/m <sup>2</sup> ]	1.00						
Wind pressure qp,90	[kN/m²]	1.00						
Material				100.05	1)=10 -			10 1
Timber	Softwood	-	1-10.0/20.	),e=100.0	10.0/20	.0,e=100		88
Material code	EN 338:2016	-	In-It	1	4	1	cm	0,0 1,1
Strength class	C24	+		15.0°	15.0°	-	↔	
Service class	2	-						
Cross-section								
Width b	[cm]	10.0	2.50	2.50	2.50	2.50	Î.	
Height d	[cm]	20.0	3,50	5,50	3,50	3,50	+	
System								
Rafter Spacing e	[cm]	100.0						
Rafter Slope a	[°]	15.0						
Rafter Length	[m]	7.00						
Number of spans	2	-						



## Standards

- EN 1995:2008/2014
- DIN EN 1995:2010/2013
- ÖNORM EN 1995:2010/2015/2019
- NTC EN 1995:2008/2018
- BS EN 1995:2012/2019
- PN EN 1995:2010

#### Loads

- Area loads, weight, snow and wind loads
- Additional loads as uniform, single or trapezoidal loads
- Man loads and wind currents in overhangs

## Calculation

The system is treated statically as a framework system, taking into account the normal force deformations and the effect of the real, specified support conditions.

All load combinations are calculated and designed according to the applicable combination regulations.

## Design settings

Optionally selectable:

- proof against wind suction (see also document <u>Roof: Loads-Design</u>)
- earthquake combinations
- fire design

For the permissible span/cantilever deflections of the respective verifications (based on the length L), the recommended values of the respective standard are preset as standard. These can be customized.

Since the negative deflection there usually determines the design result in the case of short cantilevers, this often undesirable influence can be optionally eliminated with the option "only positive deflection on cantilevers".

## Proofs of stability

For the proof of stability, a continuous tilt bracket and continuous lateral support are used as standard and the buckling length in the rafter level is limited to  $0.9 \cdot$  component length.

These boundary conditions can be adapted individually.

There are various options available for determining the stability lengths.

For each superposition, the associated effective lengths for the individual bars are determined from the eigenvalue solution. Due to numerical problems, however, the effective lengths of bars with a low normal force can be too great.

For precisely such cases, there is the option of limiting the buckling length to a maximum value.

Optionally, the buckling and tilting lengths can be specified individually for each bar.

Alternatively, the buckling/tilting length can always be set to the bar length, component length or a specified value.

## Serviceability

The serviceability verification is carried out according to the rules of EN 1995-1-1 with initial and final deformation and consideration of creep deformation.



#### Support forces

Support forces are output as characteristic maximum values and sum per action.

Characteristic support forces are transferred to the subsequent components for each load case, for which the decisive combinations are then created in the program called up.

In addition, the load cases per individual load case and the superpositions can optionally be output.

## Load Forwarding / Associated Programs

The bearing loads can (with DSP+, DPD+, DKD+) be passed on to Continuous Beam Timber HTM+, Continuous Beam Steel STM+ and Timber Column HO1+.

See also document Roof: Loads-Design.

The interface to the RSX Framework enables an alternative calculation.

Entered <u>connection details</u> (rafter base point) can optionally be passed on to the corresponding toolbox module for calculation (the corresponding item "TB Toolbox" is then displayed here).

#### SEMA import/export

"\*.sema" files can be imported/exported via File > Import or Export.

Find out more about this in the SEMA manual.





## Input

#### General information on the input fields

This program can be used to calculate according to various standards or national annexes. These standards differ considerably in terms of load approaches, combination rules, determination of the decisive internal forces and verification.

The input fields and selection options described below can therefore differ from one another depending on the selected standard.

## Wizard

After starting the program, the <u>wizard</u> opens automatically, with which you can quickly and easily create a calculable basic system.

Here you select the type of roof or rafter.

Furthermore, the necessary/most important parameters are queried here.

An item can then be further developed on this basis.

Note: the other roof types can also be called up using the "Other roof types" button in the upper menu ribbon.

## **Basic parameters**

Selection of the standard and the material. You can also enter the strength and service class as well as the specific weight here.

#### Strength class - user defined material

The strengths and stiffnesses can be adjusted. To do this, click in the input field and press the F5 key. You can enter/edit/save/load new material in the "User-defined material" pop-up menu.

Properties	д
Basic parameter ⊕- System ⊕- Loading ⊕- Design 	۹ (۵
Basic parameters	0

basic parameters		6	
Design code	DIN EN 1995:2013	-	
Consequence class	2	•	
Material		0	
Timber	Softwood	•	
Material code	Softwood Hardwood Glulam		
Strength class			
Service class	2	•	
Specific weight y	[kN/m³] 6.0	0	



## System

Note: the following entries differ depending on the selected roof or rafter type.

## Remarks

You can enter remarks about the system that optionally appear in the output.

## General

Here you define the other properties <u>depending on the selected roof type</u>.

Rafter spacing	Center distance of the rafters
Rafter type	Choice of continuous or pent roof rafters
Symmetrical	Symmetrical or asymmetrical roof
Ridge connection	Rigid, pinned or open
With ridge purlin	Yes/no
With collar beam	Yes/no

## Geometry

Depending on the selected roof type and symmetry, the appropriate input fields are displayed.

## Rafters (left / right)

- Slope a	The angle of slope of the rafters - can also be changed directly in the graphic.
- Number of fields	Up to 5 fields/sections are possible.
- Span 1, 2	Lengths of the individual spans. Span 1, Span 2, etc.
- Cantilever	Length of the cantilever.
- Overhangs	Definition of a free roof overhang.
	The overhang plays a role above all for the approach of <u>wind underneath currents</u> , but also for the consideration of the extension loads.
	Overhang = start of the rafter to the edge of the house.

## Collar beams

- Distance to the ridge	Distance of the collar beam to the ridge.
- Collar Beam Length	Display of the calculated collar beam length.
- Number of fields	Up to 4 fields with different lengths (field 1, field 2) are possible.
- Fixed	If the option is marked, the collar beam roof cannot be moved, otherwise it can be moved.
- With support	Optional supports at the collar beam ends.

Properties	<del>д</del>
····· Basic parameter	0.0
🚊 System	10
Common	
Geometry	
Support	
Cross-sections	
🗄 - Loading	
🗄 - Design	
Output	

		8
Rafter Spacing e	[cm]	100.0
Symmetric		
Connection of Ridge	Pinned	•
With purlin at ridge	Rigid	
With collar beam	Pinned Open	



Rafter left			0
Slope	α	[*]	30.0
Number of fields		1	+
Span 1	L,1	[m]	5.00
Cantilever bottom	L,btm	[m]	0.00
Overhang bottom	L,btm	[m]	0.00
Rafter right			0
Slope	α	[*]	30.0
Number of fields		1	*
Span 1	L,1	[m]	5.00
Cantilever bottom	L,btm	[m]	0.00
Overhang bottom	L,btm	[m]	0.00
Collar beam			0
Distance to the ridge		[m]	0.96
Collar Beam Length		[m]	3.33
Number of fields		1	•
Fixed			
With support at left			
With support at right			



п

0.00

0.00

3.00

0

 $\checkmark$ 

0.00

0.00

3.00

÷

+

90

#### Hip or valley rafters

Various input options are available for defining the roof envelope. The dimensions/values are displayed in the graphic for checking and can also be changed there directly.

S١	/st	tem	li	m	its

Туре

#### Single span system:

the simplest entry with a 90-degree angle, without span subdivisions, cantilever arms, floor plan angles, etc.

<u>Right-angled and symmetrical:</u> As with the single-span system, however, the top can be subdivided into spans as a result of purlins. Both sides are symmetrical. The input fields for the shift rafters can be expanded.

## Right-angled:

an asymmetrical span division is possible here.

<u>Floor plan angle freely selectable:</u> as right-angled, in addition, the input field for the plan angle can be edited.

#### Crippled hip-like:

A one-sided overhang is also offered here

 $(\rightarrow$  greater length of the shift rafters for the load introduction area).

Properties

- System

⊕ Loading ⊕ Design

Output

System limits

Angel in floor plan

Main roof base length

Adjacent Roof Pitch

Adjacent roof Base length

Jack Rafter Main Roof

Jack Rafter Adjacent Roof

Set purlins automatically

Cantilever bottom

Cantilever top

Span 1

Number of fields

Cantilever bottom

Cantilever top

Span 1

Number of fields

Height of ridge hipped/valley [m]

Main roof pitch

Туре

Basic parameter

Support Cross-sections

**Right-angled** 

Single spam system

Crippled hip-like

[m]

[m]

1

[m]

[m]

[m]

[m]

1

Right angled and symmetrical

Floor plan angle freely selectable

Overhang on both verges At right angles across heights and lengths Perpendicular over heights and angles

At right angles over heights and lengths:

Input about the height and projection length of the marginal planes.

Perpendicular over heights and angles:

Input about the height and angle of the marginal shift planes.

Angle in the floor plan	The angle between the eaves is illustrated in the graphic and can also be changed there directly.
Main roof pitch	Angle of slope on the main or secondary roof.
Main roof base length	Basic length in the direction of the main roof or the secondary roof.
Main roof projection length	edge shifters With the type "right-angled over heights and lengths/angles, the projection lengths for the main and secondary roofs are entered here.
Ridge height	Informative display or changeable value for the height of the ridge.
Main roof overhang	Overhang on the hipped roof.

#### Jack rafters (main or secondary roof)

Cantilever	Length of the cantilever arms above or below.
Number of fields	Die Eingabe von bis zu 3 Feldern ist möglich.
Span 13	Length of the individual spans.



## Support

In the Common section, to simplify the entry, you can specify whether the same (standard) mouth depth should apply to all supports or whether you want to enter this value yourself (then check the box) and whether the horizontal and vertical supports should all be rigid.

Depending on the selected roof type, you can call up the corresponding support tables.

Call up the support table(s) via the table symbol <sup>an</sup> or via the tab below the graphic.

The horizontal and vertical supports are entered. If the option is marked, the support is rigid. To enter a custom value, remove the check mark.

An (optional) mouth or incision depth [cm] weakens the rafter cross-section in the support areas.

Active

With hip/valley rafters, the supports are created

automatically as a result of the purlins of the shift rafters - if you do not want this, you can set the supports inactive using this option (you can find the option in the table entry under the tab "Supports due to purlins").

Additional supports In the case of hip/valley rafters, additional supports (e.g. as a result of supports) can be created in the table using the "+-" symbol.

L.	eft RafterSupport	Right Rafter Support	Standard Load Cases	s 🔄 Additional Load Cases	×
	No.	Horizontal Support	Vertical Bearing	Depth of Birth Mouth	3
	1	[kN/m]	[kN/m]	[cm]	
-	1 2	hgid 🗹	rigid 🗹	0.0	

Fig .: Tab under the graphic.

## Connection details of the rafter base points

The functions/dialogs for the rafter bases can be called up via the context menu of the supports.



Via "Connected programs" (in the menu above), the connection details can optionally be forwarded to the corresponding toolbox module (rafter base) for calculation.

See also Design > <u>Connection Details</u>.

Properties	<del>,</del>
Basic parameter ⊟. System Common Geometry	Q ()
Cross-sections 	
⊕ Design Output	
-	0

Common		0
Depth of birth mouth for all bearings tv	[cm]	0.0
All support translations fixed		
Left RafterSupport		0
Left RafterSupport	to the table	1 2
Right Rafter Support		0
Right Rafter Support	to the table	1 2



## Cross-sections

Number	Number of cross-sections (1 or 2).	P
Width/Height	Display of the selected or input of the cross-section dimensions.	E
Deviating cantilever	If necessary, other cross-sections than for the rafters can be selected for the cantilever arms. Check this option to display the corresponding input fields.	

Properties		4
Basic parameter     System     Common     Geometry     Support     Cross sections     Coading     Design     Output		۹.۵
Rafter left		0
Number	1	-
Width b	[cm]	10.0
Height d	[cm]	20.0
Deviating cantilever		
Rafter right		0
Number	1	-
Width b	[cm]	10.0
Height d	[cm]	20.0
Deviating cantilever		
Cantilever right ( at r	after)	0
Width b	[cm]	10.0
Height d	[cm]	20.0
Cantilever right ( at e	ave)	0
Width b	[cm]	10.0
Height d	[cm]	20.0



## Loading

See also document Roof: Loads-Design. You can also define user-defined actions here.

You can also define user-defined actions here.		Basic parameter ⊕System ⊖Loading			۹ 🕲
Dead Load		Dead Load Snow and Wind			
Dead weight autom.	ad weight autom. Here you choose whether you want to calculate with or without dead weight.				
Rafter		Settings			0
g1/g2/g3	The loads "g1" and "g2" act over the entire	Dead weight automatically	,		
	length of the rafter. Your load coordinates are	Rafter 🔕			
	related to the roof area. The loft conversion load "g3" acts from the edges of the house ground to the ridge or between the edges of the house	Roofing	g1	[kN/m³]	1.00
		Construction	g2	[kN/m²]	0.00
	around	Loft conversion	g3	[kN/m²]	0.00
		Loft Conversion bottom	gb	[kN/m <sup>2</sup> ]	0.00
Loft conversion botttom gb	The program applies the lower load on the collar	Roof payload (man load)		single load only	
	beam root between the bottom support and the	Roof live loads at reaction forces			
	conar beam.	PV-system left		[kN/m²]	0.00
Roof payload (man load)	No or only single load.	PV-System right		[kN/m²]	0.00
Roof live load at support for	ces If the option is marked, live loads of	Collar beam			0
	category H are taken into account at support	Persistent load	gk	[kN/m²]	0.60
	forces and load transfer, otherwise not.	Live load	pk	[kN/m²]	1.50
PV-system	Photovoltaic system: select this option to show the corresponding parameters.	Action		Cat. A: dome	stic, resic 🔻

Properties

Basic parameter

## Collar beam

Both permanent loads gk and live loads pk can be specified for collar beams. The live loads are assumed to be one-sided for the asymmetrical load cases.

## Snow and wind

#### Basic values

Town selection

Basic values This button opens the snow and <u>wind load dialog</u>.

Display of the municipality selected under "Basic values". If you would like to enter your own values instead, uncheck this option and enter the values below.

## Boundary conditions for snow loads

Snow skirt and snow accumulation can be selected left and right. Since the factors for exceptional snow loads can differ between the National Annexes, the *Cesl* value can be modified if necessary.

## Boundary conditions for wind loads

Ridge height	Height of the ridge above the terrain.		
Roof length	Roof length as the width of the wind attack b.		
Building length	Building length as the length of the wind attack for walls.		
Wind pressure refere	nce area If this option is checked, the reference area to which the aerodynamic coefficients for the component verifications are referred can be adjusted.		
Approach wind	Pressure and suction alternatively, only pressure, only suction.		
Wind range	With the <u>ridge/valley rafter</u> , you can optionally choose which wind range is to be used as the basis for the averaged wind load on the main/secondary roof. Otherwise the program automatically takes the area with the greatest wind pressure.		

#### Loads for Calculation

Load values acc. to code

Deactivate this option to be able to enter your own values.



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Basic Values			۵
Country for loads		German	
Basic Values			
Town selection			
Terrain elevation	Altitude	[m]	0.00
Snow action group		Snow loads H	H < 1000 -
Ground Snow Load	sk	[kN/m²]	1.00 🔽
Wind pressure	qp.0(h)	[kN/m²]	1.00 🗹
Wind pressure	qp,90(h)	[kN/m²]	1.00 🗹
Boundary conditions f	for snow lo	ads	0
With snow guard on the	left		
With snow accumulation	left		
With snow guard right			
With snow accumulation	on the right		
With Accidental Snow	Cesl		2.30
Boundary conditions f	for wind loa	ads	0
Total ridge height	h	[m]	6.00
Length of Roof	b,Roof	[m]	20.00
Building length	b, Wall	[m]	20.00
Wind pressure reference	area	[m²]	10.00
Approach wind		Pressure and	Suction : •
Wind direction for the gra	aphic	Pressure and	Suction alter
With internal wind pressu	ire	Only suction	
Loads for the Calculati	ion		0
Load values acc.to code	**		



## Load cases

You can use the "to the table" <sup>and</sup> symbol or the tabs under the graphic to access the tables for the standard load cases or the additional load cases.

## Settings

Equal $\gamma G$ for permanent loads	If the option is selected, permanent loads are also combined, otherwise they are all applied the same.			
as dependent load cases	If the option is selected, the loads are assumed to be "dependent" and combined. Note that when you choose a dependency, you must ensure that the loads always occur together at the same time!	Sr Sr W In Va		
Variable load on Collar Beam	If the option is selected, the live load on the <u>collar beam</u> is considered independently span by span.	Or Dr		
Omit opposing	If the option is selected, standard load cases/combinations with loads whose expected deformations are in opposite directions are omitted.	St Ac Cc Cc		
		A		
		A		

Properties	<b>4</b>
Basic parameter     System     Journal Cooling     Sonow and Wind     Joad Cases     Design     Output	Q (2)
Settings	0
Equal yG for permanent loads	$\checkmark$
Snow eaves loads as <mark>d</mark> ependent load cases	
Wind undercurrent as dependent load cases	$\checkmark$
Internal wind pressure as dependent load cases	$\checkmark$
Variable load on collar beam is field dependent	
Omit opposing standard load cases	$\checkmark$
Omit opposing combinations	$\checkmark$
Load Cases	0
Standard Load Cases	table 🔠 🏈
Additional Load Cases	table 甜 🗿
Copy all snow load cases	
Copy all load cases	1
Copy all man-load cases	1
Alternative Groups	0
Alternate Groups 🛛 🕚 1/3 🚺 [	🍦 × 🇃 🌛
Name	ls H < 1000 m)
Remark	Alterna 📝
Number of load cases	3

## Standard Load Cases

Wind and snow loads are automatically generated as "Standard Load Cases" in accordance with the applicable standards. These load cases can be switched on and off in the table individually or as a whole in the "Active" column, but they cannot be edited.

"Standard load cases" can be copied to "<u>Additional load cases</u>" and edited there ("Copy all snow, wind, man load cases").

To display the table, click on the "Standard Load Cases" tab below the graphic.



## Additional Load Cases

Here you can create your own load cases or copy "Standard Load Cases" in order to add or change them.

Note: for a new table row click on the right by symbol.

Left	RafterSupport	Right Rafter	Support Standard Load Cases	Additional Load Cases					×
	Name	Short Name	Action	Alternate Group	Remark	Active	Copy from load case	Loads	2
1	Copy of Drifftet snow	(1)	Snow loads H < 1000 m	110 (Snow loads H < 1000 m)	This is a copy AND NOT a link		Drifftet snow on rafter leftsides	Edit (2)	L.
							Dead Load Snow on rafter Difflet snow on rafter leftsides		雷
							Drifftet snow on rafter righttsides Wind from left luv(Pressure)+lee(Pressure)		····

Name Enter a (own) load case name.

Short Name Enter a short name, eg for display in tables.

Action Selection of the action from a list.

Alt. group Load cases to which you assign the same alternative group number (>0) do <u>not</u> act simultaneously (but rather "alternative"). Example: Wind loads from different directions.

Remark Free comment text.

Active Load cases can be set temporarily inactive here (remove tick). During the calculation, all load cases marked as "active" are automatically superimposed according to the applicable combination rules, taking into account the alternative groups.

Copy from load case Here you can select previously entered load cases. The selected load case is then copied and can then be edited/adjusted.

Loads With this button you call up the input table of the loads for the load case.

elation I load I load	Member Rafter left	load type	Orientation	Dist					-			
i load i load	Rafter left		2	10 12 12 14 A	L	W1	W2	Dimension	Factor	Rema	rk	2
load load	Rafter left		0	[m]	[m]							
load	THE RESIDENCE AND A DECK	Uniform load	vertical to projection	2.77	1.000	0.32 🖾	1.775	kN/m²	1.00	sLd		
	Rafteringht	Uniform load, in sections	vertical to projection	0.00	5.00	0.63 🔛	1.12	kN/m²	1.00	sR		钮
		Uniform load Uniform load, in sections										
		Trapezoidal load Trapezoidal load, in sections										*
п	oforonao f	for the lead, line lea	d (component role	tad) ar a	roolo	nd (araa	rolato	4)				
R	ererence i	or the load: line loa	d (component-rela	ted) of a	rea loa	au (area-	relate	u).				
С	omponent	: Rafters left, right,	collar beam.									
S	ingle load											
U	niform loa	d (continuous or in	sections)									
Т	rapezoidal	l load (continuous d	or in sections)									
n Lo	oad alignn	nent depending on	load type:									
Р	oint load:	1 5	51									
- \	vertical (gl	lobal down)										
-	horizontal	(global)										
- 1	transverse	e (to the member ax	is)									
-	longitudina	al (in the direction o	of the member axis	.)								
Li	ine load:											
- \	vertical to	beam (global dowr	on member)									
- \	vertical to	projection (global o	own on projection	)								
- 1	transverse	e to the beam (perp	endicular to the me	ember av	(is)							
S	pecifies th	e distance of the lo	ad in x-direction fr	om the s	start of	f the con	npone	nt.				
S	pecifies th	e length of the line	load in x-direction.									
L	oad value	at the beginning or	at the end of the li	ne load.								
A	load value	e compilation can b	e called up using t	he "arro\	w syml	bol" 🛄						
r	R S U T - - - - - - - - - - - - - - - - - -	Reference f Component Single load Uniform loa Trapezoida Load alignn Point load: - vertical (gl - horizontal - transverse - longitudin Line load: - vertical to - vertical to - transverse Specifies th Specifies th Load value A load value	Reference for the load: line loa Component: Rafters left, right, Single load Uniform load (continuous or in Trapezoidal load (continuous or Load alignment depending on <u>Point load:</u> - vertical (global down) - horizontal (global) - transverse (to the member ax - longitudinal (in the direction or <u>Line load:</u> - vertical to beam (global down - vertical to projection (global down - vertical to projection (global down - vertical to projection (global down - transverse to the beam (perper Specifies the distance of the lo Specifies the length of the line Load value at the beginning or A load value compilation can b	<ul> <li>Reference for the load: line load (component-relation Component: Rafters left, right, collar beam.</li> <li>Single load</li> <li>Uniform load (continuous or in sections)</li> <li>Trapezoidal load (continuous or in sections)</li> <li>Load alignment depending on load type:</li> <li><u>Point load:</u> <ul> <li>vertical (global down)</li> <li>horizontal (global)</li> <li>transverse (to the member axis)</li> <li>longitudinal (in the direction of the member axis)</li> <li>vertical to beam (global down on member)</li> <li>vertical to projection (global down on projection at the beam (perpendicular to the member axis)</li> <li>transverse to the beam (perpendicular to the member)</li> <li>transverse to the beam (perpendicular to the member)</li> <li>transverse to the beam (perpendicular to the member)</li> </ul> </li> </ul>	<ul> <li>Reference for the load: line load (component-related) or a Component: Rafters left, right, collar beam.</li> <li>Single load</li> <li>Uniform load (continuous or in sections)</li> <li>Trapezoidal load (continuous or in sections)</li> <li>Load 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Factor The load value is multiplied by this freely definable factor.

Remark Optional entry of free text.

See also document Roof: Loads-Design.



## Design

## Design settings

## Calculation rules

 Deflection at cantilevers: If required, the verification of deflection at the cantilever can be switched off completely here.

Only positive deflection on cantilever arms

For short cantilever arms the negative deflection there usually determines the design result, this often undesired influence can be eliminated by selecting the option "Only positive deflections on cantilever arms".

- The reference length for the total deflection

For the serviceability verifications, you can specify whether the member or the component length should be taken into account as the reference length for the total deflection design. For the local (member-by-member) deflection verification, the member length is always automatically used as the reference length.

- Creep influence in compression:
   If this option is selected, the stiffnesses due to creep from permanent and quasi-permanent load components are reduced.
- kmod Wind averaged

If the option is selected, the kmod coefficient for wind is used as the mean value for the classes of load durations short and very short.

- With check of withdraw

If the option is checked, proof against withdrawal is provided. The cpe1 values are used as a basis for determining the wind loads. The verifications are carried out in the design situation "Equ".

The case that the load application area of the rafter is underflowed by the wind like a cantilever when the wind flows on the gable side can be taken into account with the option "With gable-side overhang".



Calculation Rules		0			
Deflection at cantilevers	consider	+			
Reference length for total deflection	Member Length	-			
Influence of creep under pressure		$\checkmark$			
kmod Mean wind		$\checkmark$			
With check of withdraw					
Wind loads for lateral flow in	Inconvenient area	-			
Ultimate Limit State		0			
Fire design					
calculate always simplified					
Fire resistance class	R 30	•			
Charring all sides		$\checkmark$			
Charring acc.to code		$\checkmark$			
Buckling/Tilting Lengths		0			
Selected member	Rafter left	+			
Cold Design		0			
Buckling in plane	from eingenvalue lim	ited to 👻			
limited to L*		0.90			
Buckling out of plane	kept continuously	+			
Tilting	kept continuously				
Fire Design	Member length				
Buckling in plane	Member length + Cantilever				
Buckling out of plane	Member wise user va	alues			
Tilting	Member Length	-			
Serviceability		0			
w,inst	[1/]	300			
w,net,fin	M	300			
w,fin	[/]	200			



## Ultimate Limit State

- Fire protection design:

Check this option to display the input fields for the fire design. If this option is selected, the stress verifications are also carried out in the event of a fire.

- calculate always simplified:

If the option is selected, the simplified method with reduced cross-sections is always used in the analysis for fire design. Otherwise the program chooses between the simplified and the exact method (with reduced properties).

- Fire resistance class:

Selection of the desired fire resistance class or user-defined input of the burn time.

- Charring all sides:

Uncheck to select individual sides for fire exposure.

- Charring according to code:

Remove the tick if you want to specify the charring rates  $\beta$ n for the individual sides yourself, otherwise the standard values will be used.

- no reduction in stiffness:

Depending on the selected standard (NA), the modulus of elasticity of compressively loaded components is reduced by means of kdef in stability checks if the proportion of permanent loads in the total load is large. This leads to smaller (less favorable) buckling coefficients kc.

See also document Fire protection analysis timber.

## Buckling and tilting lengths

- Selected member Selection of the component (rafter, collar beam).

## Cold Design

The boundary conditions for the buckling lengths in and out of the rafter plane as well as the tilting length or the lengths themselves can be specified separately for each component.

The following conditions are available:

- continuously fixed
- Buckling/tilting length = bar length
- Buckling/tilting length = component length
- from the determination of the eigenvalue for each load combination, optionally with an upper limit
- Specification of a constant value for each bar
- Specification of the values for each individual bar

In the event of a fire, the option of determining the eigenvalues is not applicable, since the cross-section values would vary depending on the design method for the individual verifications!

## Fire Design

Analogously as under Cold Design.

#### Serviceability

w,inst	Limit of elastic deflection
w,net,fin	Limit value of the sum of elastic deflection and creep deformation
w,fin	Limit of the final deformation



## **Connection Details**

Connection details of rafter base points

- nothing selected,
- with notch and threshold,
- with straight collar,
- with haunched collar.

With the Edit button you can open the corresponding dialog. The respective parameters are self-explanatory (graphic).

Optional forwarding of connection details to the toolbox (connected programs in the ribbon).

For graphical input, see also the "<u>Support</u>" chapter.

Properties		<b></b>
Basic parameter System Loading Design Design settings Connection Details Output		۹ 🏻
		0
Rafter base on the left	with cleat with haunt	•
Eda	no selection	

Rafter base on the right

Purlin connection - support

with notching and sill

with a straight collar

	with	haunt			-
Common					×
Norm		DIN EN 1995-1-1/N	VA:2013-08		d
Rafter				/	X
Timber		Softwood	-		7
Strength class		C24	*		. /
Sill					×tv
Timber		Softwood	-		
Strength class		C24	-		
Cleat				×	$\times$
Timber		Softwood	•		/1k /
Strength class		C24	-		X A.
Coefficients				dk	~ <u>_</u>
kc90 user-defined					
System					
Rafter Slope	α	[1]	30.0	- e	t
Rafter Width	b	[cm]	10.0		
Rafter height	d	[cm]	20.0		
Rafter Spacing	e	[cm]	100.0		
Sill height	ds	[cm]	8.0		a
Incision depth	tv	[cm]	0.0		
Sill overhang	ue	[cm]	0.0		
Cleat width	bk	[cm]	0.0		b ue
Cleat length	lk	[cm]	0.0	1	1 1 1
Cleat thickness	dk	[cm]	0.0		bk



## Calculation

To calculate, click on the "Calculate" button in the upper menu bar.

#### Auto calculation option

The option for automatic calculation after each input can be switched on under File - Settings if the runtime behavior of your computer is satisfactory, so that a new calculation can be carried out immediately with each input change.

For more information see the document Roof: Loads-Design: Calculation





## Output

Before the output click on the symbol "Calculate" in the upper menu ribbon.

After the calculation, the utilization is displayed at the bottom right in the graphics window and offers a good overview of the economic efficiency of the system entered.

## Output profile

By clicking on the various output options, you determine the scope of the output.

## Results

You can view the result graphics via the "Results" tab in the upper menu ribbon.

Here you can also the options of scaling graphics and taking snapshots for the output.

## Output as a PDF document

The output document is displayed in PDF format via the "Document" tab and can be printed.

See also document Output and printing.

Properties	<b>4</b>
Basic parameter	0.0
🗄 System	
🗄 - Loading	
Output	

	0
Output Profile	Standard 🝷
System Graphics	User defined
Material Characteristics	Standard
Cross-section Properties	Detailed
Loads table	
Standard Load Cases	
Additional Load Cases	
Load cases with loads in table	
Load Combinations	
only decisive load combinations	
Results separated by situation	
Results witch coefficients	
Support Reactions per load case	
Support Reactions per load combination	
Support Reactions Max/Min per action	
Support Reactions Max/Min per load combination	
Support reactions per [m]	
Connection forces at ridge per LC	
Connection forces at ridge per combination	
Connection forces ridge Max/Min	
Connection forces Collar beam fro each load case	
Connection forces Collar Beam per combi	
Connection Forces Collar Beam Max/Min	
Graphics Exploitation	
Graphics Stresses	
Graphics Normal Forces	
Graphics Deformations	
Graphics Support Reactions	
Tables with legends	$\checkmark$

	New	item (Pi	oject:	RSX)* - Da	ich+ Design of	Roofs 01,	/22C (R-2022-1/P	04)							×
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Envelope Max/Min *	Nx	My	Vz	Support [kN]	Rotated Support [kN]	Support [kN/m]	Rotated Support [kN/m]	Normal stress	Bending Shea Stress	Eta Stress	Eta Equilibriur	Eta m Shear	Scaling		
Situation				In	ternal forces				Stresses	Le	vels of Cap	acity	Pict	tures	\