FRILO Software
A NEMETSCHEK COMPANY

Rafter Purlins D7+

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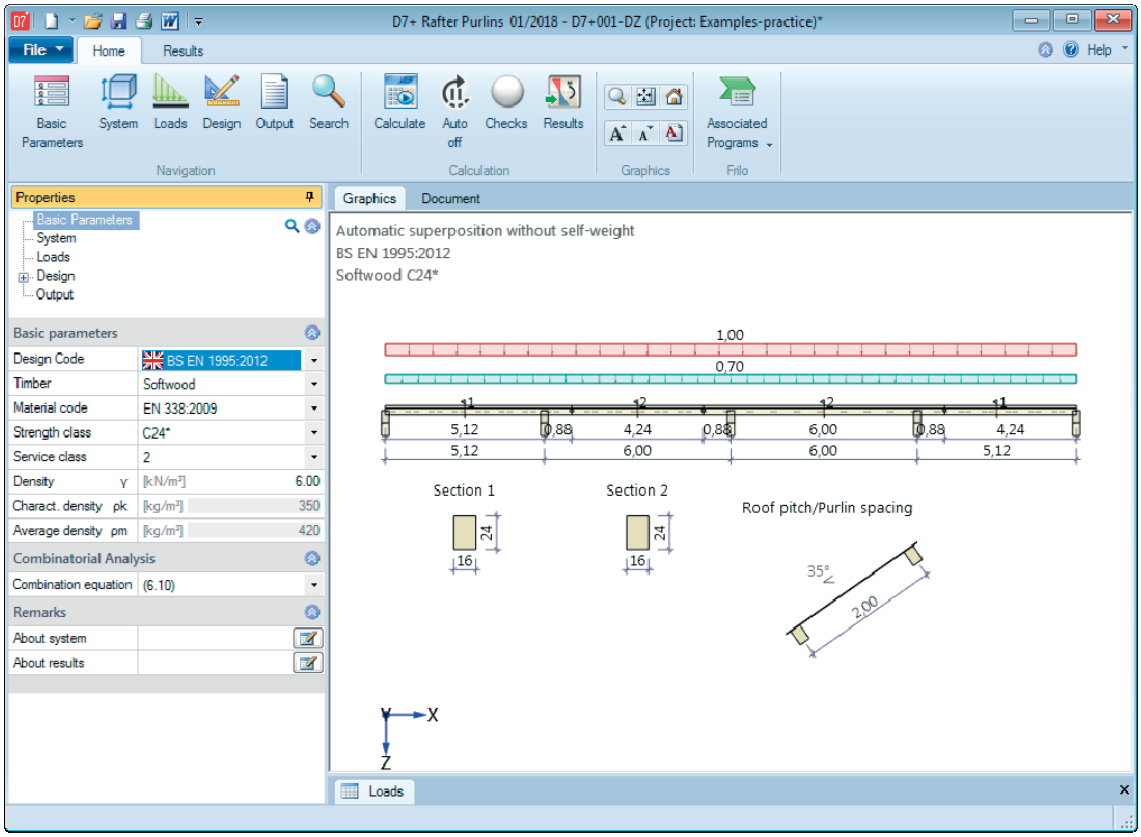


Rafter Purlins - D7+

Contents

Further information and descriptions are available in the relevant documentations:

Basic Operating Instructions-PLUS	General instructions for the manipulation of the user interface
FCC	Frilo.Control.Center - the easy-to-use administration module for projects and items
FDD	Frilo.Document.Designer - document management based on PDF
FDC – Menu items	General description of the typical menu items of Frilo software applications
FDC – Output and printing	Output and printing

Application options

Rafter purlins combine the functions of rafters and purlins. They are supported by trusses and run in parallel to the eaves.

Available standards

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

The software designs

- single-span purlins,
- tie purlins and
- articulated purlins

for roofs with an inclination of up to 45°, which are loaded by self-weight, snow and wind.

The loads can be selected in accordance with EN 1991 (+NA).

The design is performed in accordance with EN 1995 (+NA) and the respective superposition regulation is considered.

The snow and wind loads as per EN 1991 (+NA) can be defined by selecting a climatic zone specific to the respective country or by selecting a municipality in Germany, for instance. The loads are automatically assigned to action groups.

In the output, the actions, the combinations of actions and the results are presented in detail for each load case and each load case combination.

The decisive verifications of the load-bearing capacity and the serviceability complete the output documentation.

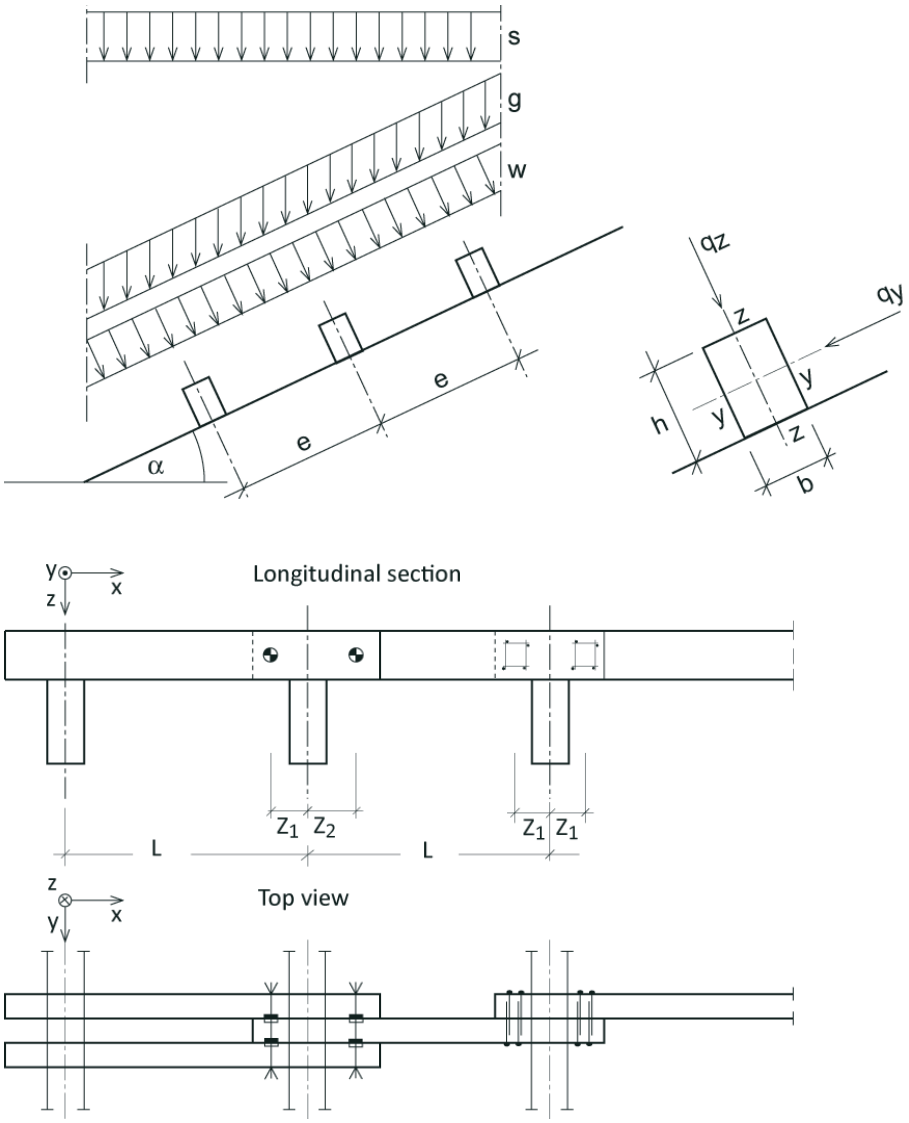
The verifications of the fasteners are performed in accordance with EN 1995 (+NA) and are also included in the output.

Tie purlin

Currently, systems with equal span lengths exposed to uniformly distributed loads can be calculated.

Available fasteners for the design of the tie points:

- Nails (round wire nails and plain-shank nails as well as special nails with profiled shanks)
- Special dowels



Articulated purlin

For articulated purlins, you can choose between structural systems with equal support distances and systems with smaller end spans. The latter option offers the benefit of identical cross sections, hinge forces and hinge spacing. The first hinge can be in the first interior span or in the end span. For reasons of stability after the failure of a span, hinged spans and hingeless spans (Gerber girder) should alternate in the selected structural system.

The following fasteners are available for the design of the hinges:

- Bolts
- Special dowels

Depending on the design of the hinge additional verifications might be required.

The following applies to all systems

All load case combinations are examined and the internal forces decisive for the design are determined.

Cross-breaking strength analyses are performed in accordance with EN 1995.

The stiffness of the fasteners in the connections is not considered in the determination of the stiffness and of the internal forces.

The deflection of articulated purlins is calculated as for a continuous beam. The stiffness of the double cross sections above the supports in not considered. According to the reference literature, this method balances out the disregard of the stiffness of the fasteners.

The purlins must be secured against tilting and uplift at the supports. A separate verification of the uplift resistance is required in the area of the intersecting building edges.

In connection with large span widths, bends could occur at the hinges and must be considered in the constructive layout of the roof skin.

Basis of calculation

The basis of the calculation of single-span purlins, tie purlins and articulated purlins is provided by EN 1995 and its national loading regulations for EN 1990 and EN 1991.

It is assumed that the purlins are installed underneath the roof skin and are sufficiently secured against tilting and uplift at the supports.

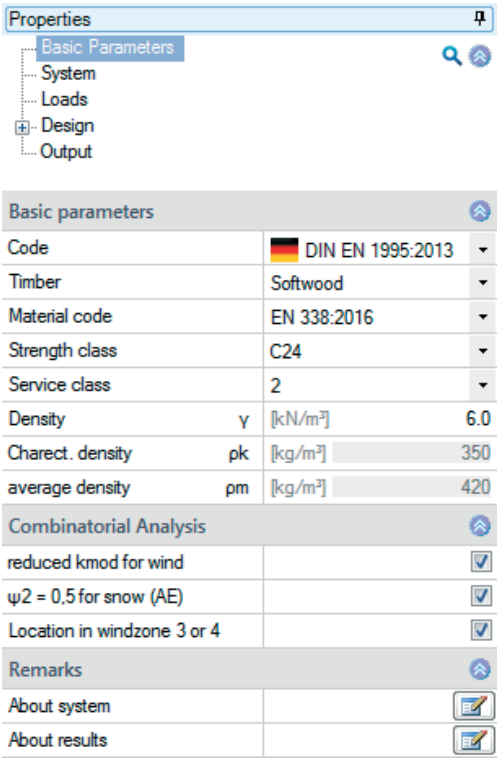
The structural calculation of the decisive internal moments, the bearing forces, the deflections as well as the overcoupling geometry is performed with the help of coefficient tables.

Bearing stress, shear stress, tilting stability and man load resistance verifications are neglected in the cross-section design. If required, these stresses and loads must be considered in addition.

Definition of the structural system

Definition wizard

The wizard is automatically launched when you start the software. It supports the user in defining the most important parameters for a new item.
With the help of the wizard, you can quickly define a structural system and gain a first impression of the results. Subsequently, you can adjust secondary parameters in a second step.
Note: You can disable the automatic start of the wizard via the corresponding option on the bottom of the window.



Basic parameters

Select the desired standard and the material.

Species of timber:
- Softwood
- Hardwood
- Glulam

Combinatorial analysis

The available selection options and data-entry fields depend on the selected standard

kmod	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 in the accidental design situation under snow load. (See introductory decree of the federal states, e.g. Baden-Württemberg)
Wind zone	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.
Consequence class	select the consequence class to determine the partial safety factors.
Combination equation	select the equation from EN 1990 that should be used for the load combination in the permanent/transient design situation (6.10 and 6.10 a/b).

System

Roof pitch — roof pitch α

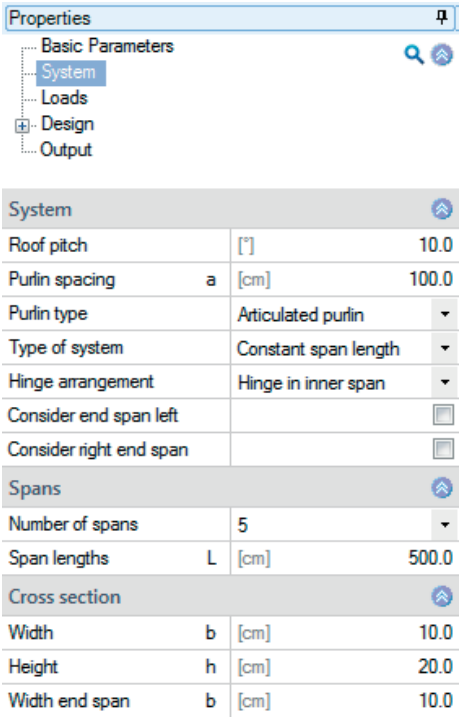
a — purlin spacing in the roof plane

Purlin type
- single-span purlin
- tie purlin
- articulated purlin

System type
- equal span lengths
- smaller end spans

Hinge locations
- in interior span
- in end span

Consider end span — check this option to take the end span into account in the determination of the tying/articulation points.



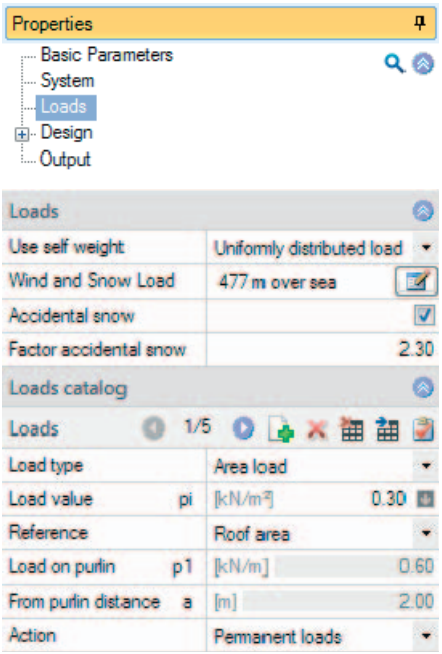
Spans

n — number of spans of the rafter purlin system (up to 10)

L — length of the spans

Cross section... — enter the dimensions of the cross section, width b and height h

Loading



Self-weight	Disregard/Uniformly distributed load/Exact (frame)
Wind & snow	displays a dialog allowing you to define the wind zone (by selecting a municipality in Germany) and the associated values as well as other wind and snow parameters. *The generated loads are added to the load list. They cannot be edited subsequently. You can delete entries from the list, however.*
Snow	(only in comb. with DIN EN 1995): check this option to include snow as an accidental load (e.g. in the Northern Lowlands of Germany).
Factor	(only in comb. with DIN EN 1995): factor for the accidental snow load; typically, 2.3 in the Northern Lowlands of Germany

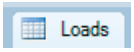
Loads

Enter the values for the first load directly in the corresponding data-entry mask.

Add additional loads with the help of the load toolbar:

- see Data entry via tables (Basic Operating Instructions)

To add loads, always set up a new entry first by activating the  button (an empty data-entry mask is displayed each time).

Alternatively, you can enter additional loads also in a well-structured load table - click on the 

tab (below the graphical representation) to access the table.

Load type	uniform linear load/area load
Last value pi	Direct entry of the load value or call of the load value combination via the "arrow symbol"  - see description in the program LAST+.
Reference	base area/roof area
Action	allows you to select an action that is assigned to this load: permanent, permanent with small variations, wind load, snow below/above 1,000 m altitude

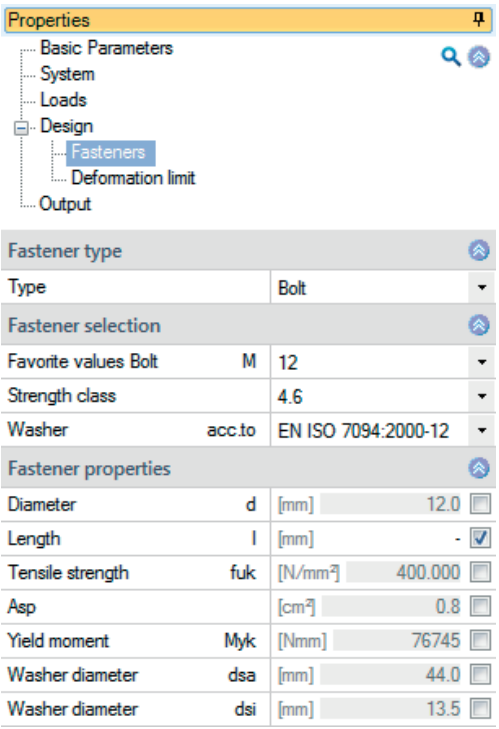
Design

Fasteners

The fasteners available for selection depend on the selected type of purlin.

Type	special dowels, nails, bolts (only in comb. with articulated purlins)

If you need more information on a parameter or data-entry field, click on the field/option to display a brief help text in the lower area of the window.



Special dowels:

Dowel type: A = joint ring
C = toothed plate

Deformation limits

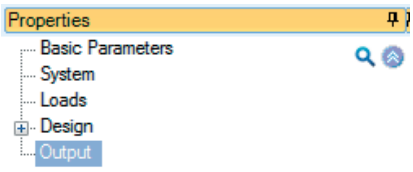
Permissible deflections

Perm. wInst	permissible initial deflection wInst(standard) = L/300
Perm. wNetFin	permissible total deflection wNetFin(standard) = L/300
Perm. wFin	permissible final deflection wFin(standard) = L/200

Output & results

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

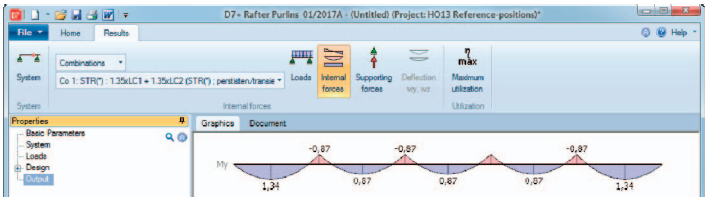
The different options allow you to define the scope of data to be put out.

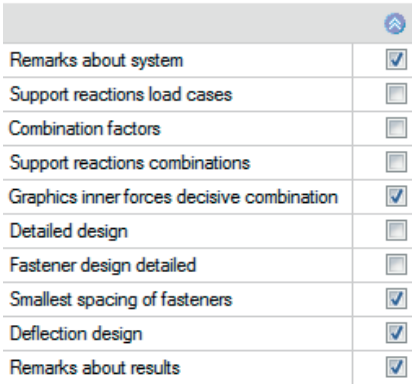


Click on the 'Document' tab above the graphical window to display the output data in PDF format - see also FDC - Output and printing_eng.pdf.

Result graphs

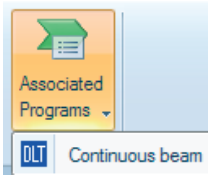
To display the result graphics, click on the button 'Results' in the upper toolbar:

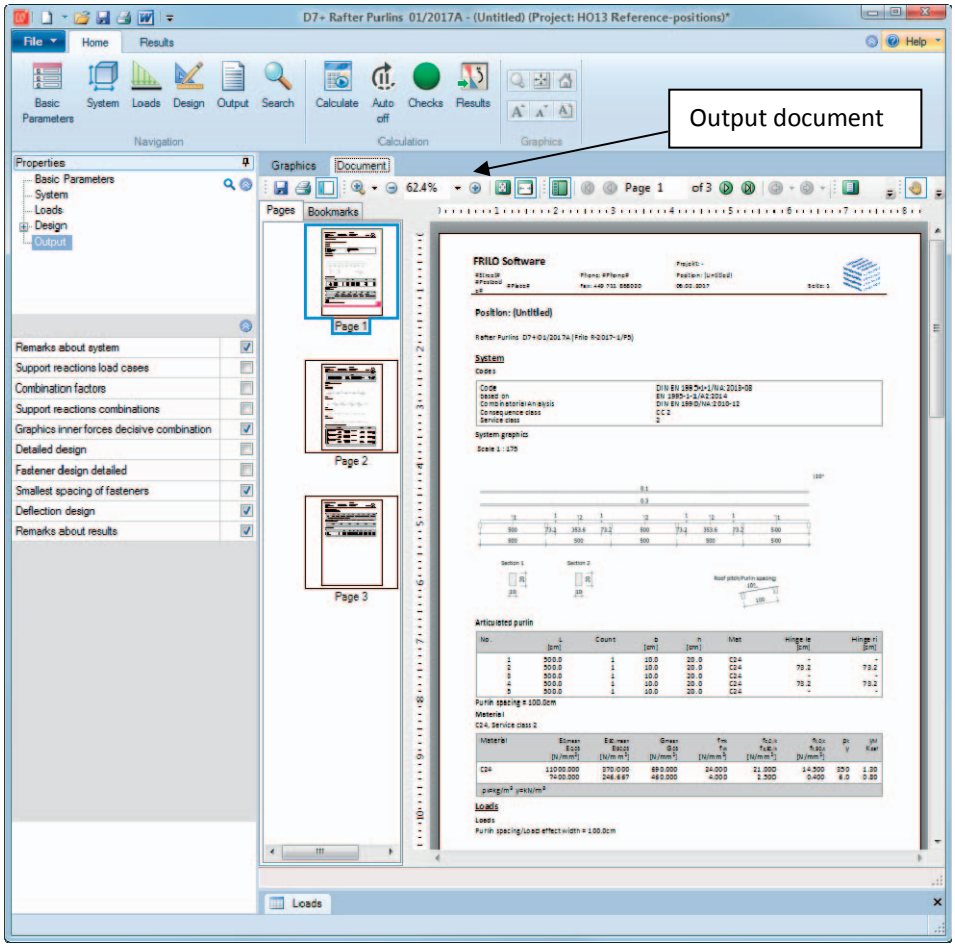




Interface to the Continuous Beam

Single-span and tie purlins can be transferred to the program Continuous Beam DLT via the "Associated Programs" button.





Reference literature

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/2/ Brüninghoff, H. und Probst, T.: Genagelte Koppelpfetten mit glattschaftigen Nägeln nach DIN 1151. Research report on behalf of the Entwicklungsgemeinschaft Holzbau. Holzwirtschaftlicher Verlag der Arbeitsgemeinschaft Holz e.V., Düsseldorf 1986

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/5/ DIN 1052:2004/2008

/6/ EN 1995:2004/2008