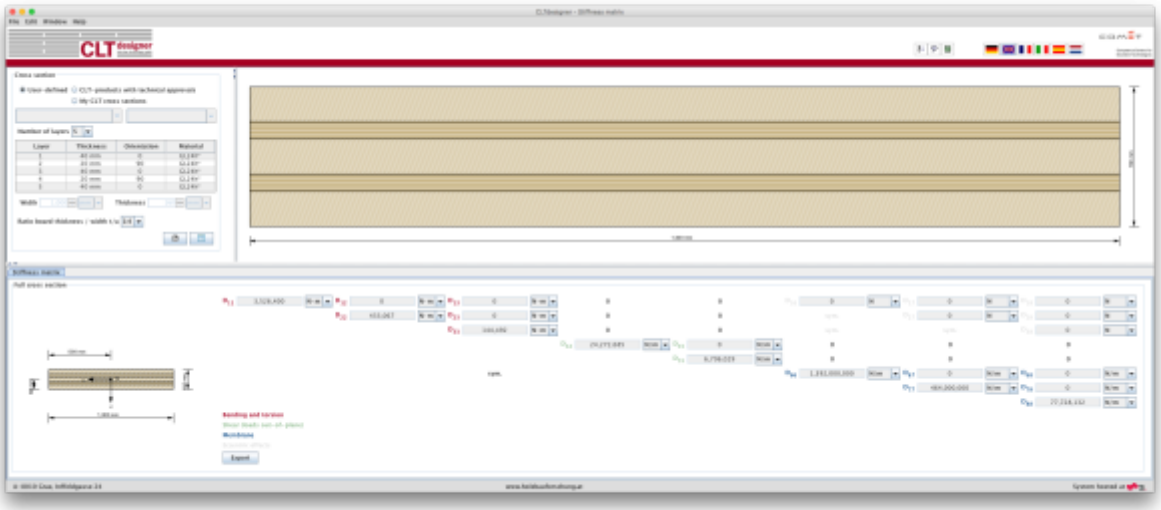
Module "Stiffness matrix"

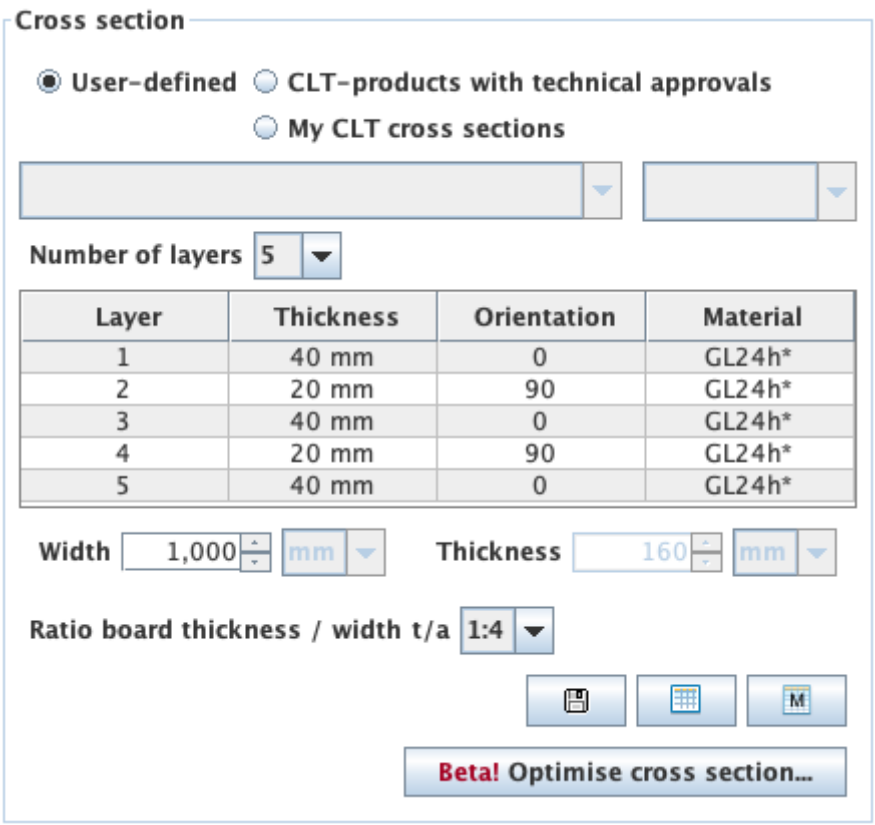


Input data

Cross section

The cross section can be defined by the user or by choosing a typical cross section of a proprietary CLT product. There is also the possibility to save own CLT cross sections in a library. The elements are subdivided by the number of layers.

If a user-defined cross section is entered, the thickness and orientation of each layer can be changed. Furthermore, the material can be changed for all layers. The thickness of each layer has to be within the range of 6.0 mm to 45 mm. In the case of proprietary CLT products, the strength class of lumber and the orientation can be changed. If the orientation is changed, the whole cross section is rotated.



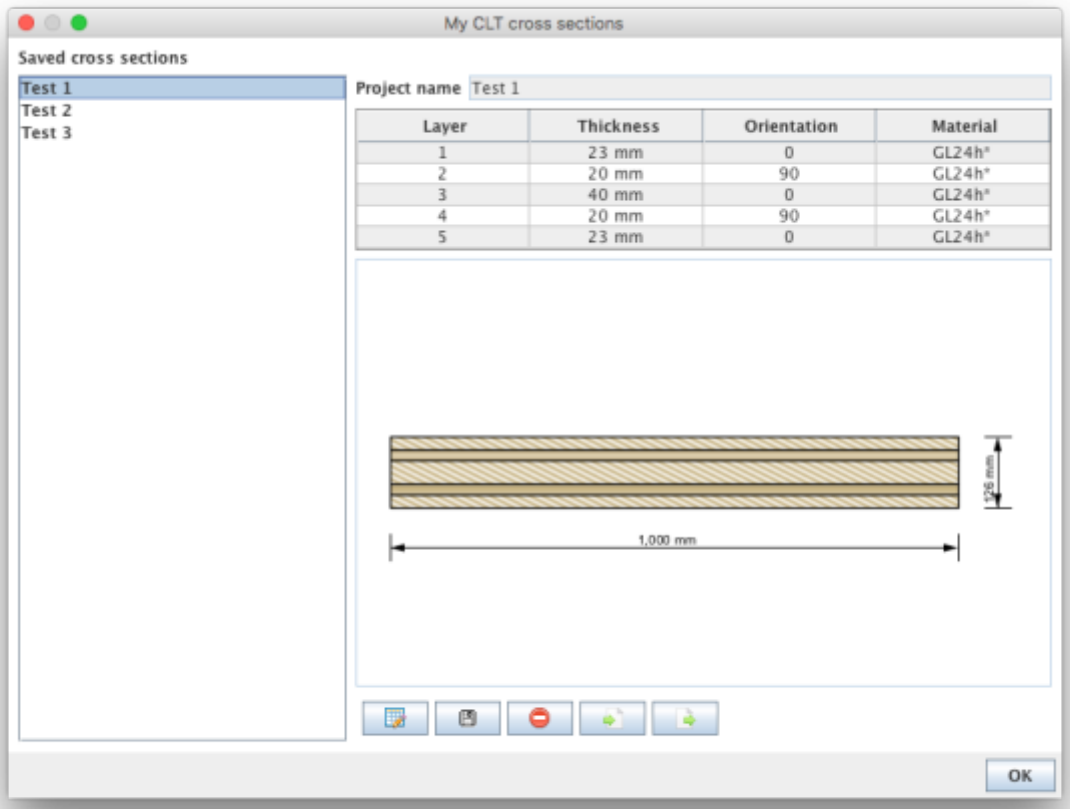
The width of the CLT plate strips can be also defined in this field. The default value is set to 1 m. The thickness of the CLT plate is calculated automatically based on the thickness of the single layers.

The ratio of board thickness to board width can also be changed here. The default setting is 1:4.

My CLT cross sections

By clicking the button  the current cross section can be stored in the library and be retrieved by selecting "My CLT cross sections" later on.

The library can be displayed with the button  .



- The edit mode can be entered by clicking on  . Currently, only the name of the stored cross section can be changed.
- With  the changes are saved.
- With  the chosen cross section in the sidebar can be removed from the library.
- With  cross sections from a csv file can be imported.
- With  the cross sections from the library can be exported to a csv file.

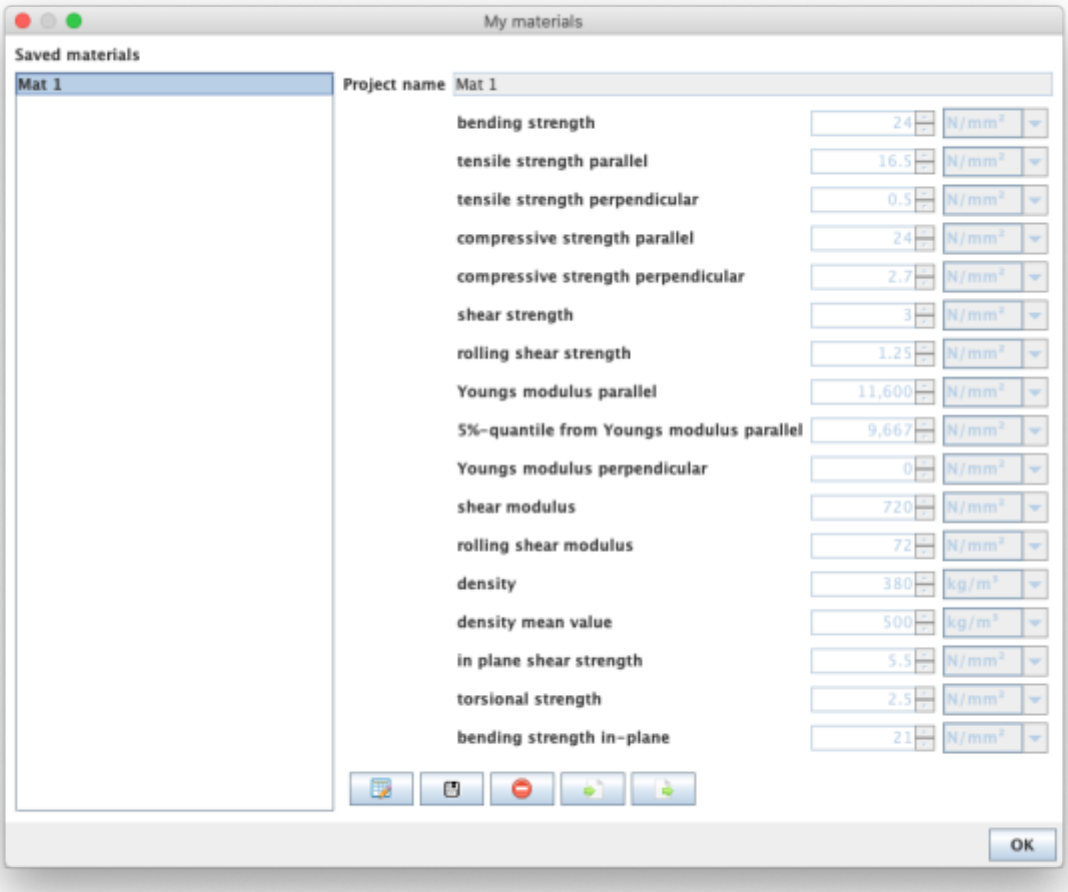
Syntax of the csv file

name;number of layers n;layer thickness in [m] t_1 to t_n;orientation of the layers o_1 to o_n (0 or 90);name of material

Example:
Test layup;5;0.03;0.02;0.02;0.02;0.03;90;0;90;0;90;GL24h*

My materials

With the button  the material library can be displayed.



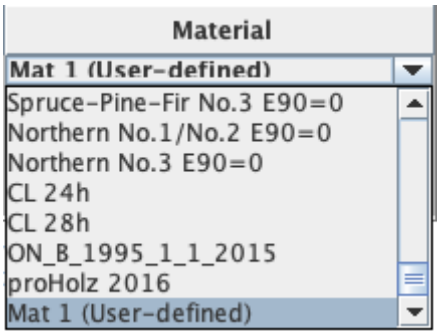
- With  the edit mode can be entered.
- With  the changes are saved.
- With  the chosen material in the sidebar can be removed from the library.
- With  materials from a csv file can be imported.
- With  the materials from the library can be exported to a csv file.

Syntax of the csv file

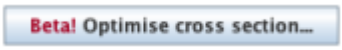
1. row: description of the parameters
2. row: units of the parameters
3. row: value
delimiter: ";"

Example:
Name;f_m,k;f_t,0,k;f_t,90,k;f_c,k;f_c,90,k;f_v,k;f_r,k;E_0;E_0,05;E_90;G;G_r;rho_k;rho_mean;f_v,k,IP;f_T,k;f_m,k,IP
;N/mm2;N/mm2;N/mm2;N/mm2;N/mm2;N/mm2;N/mm2;N/mm2;N/mm2;N/mm2;N/mm2;kg/m3;kg/m3;N/mm2;N/mm2;N/mm2
Mat 1;24;16.5;0.5;24;2.7;3;1.25;11600;9667;0;720;72;380;500;5.5;2.5;21

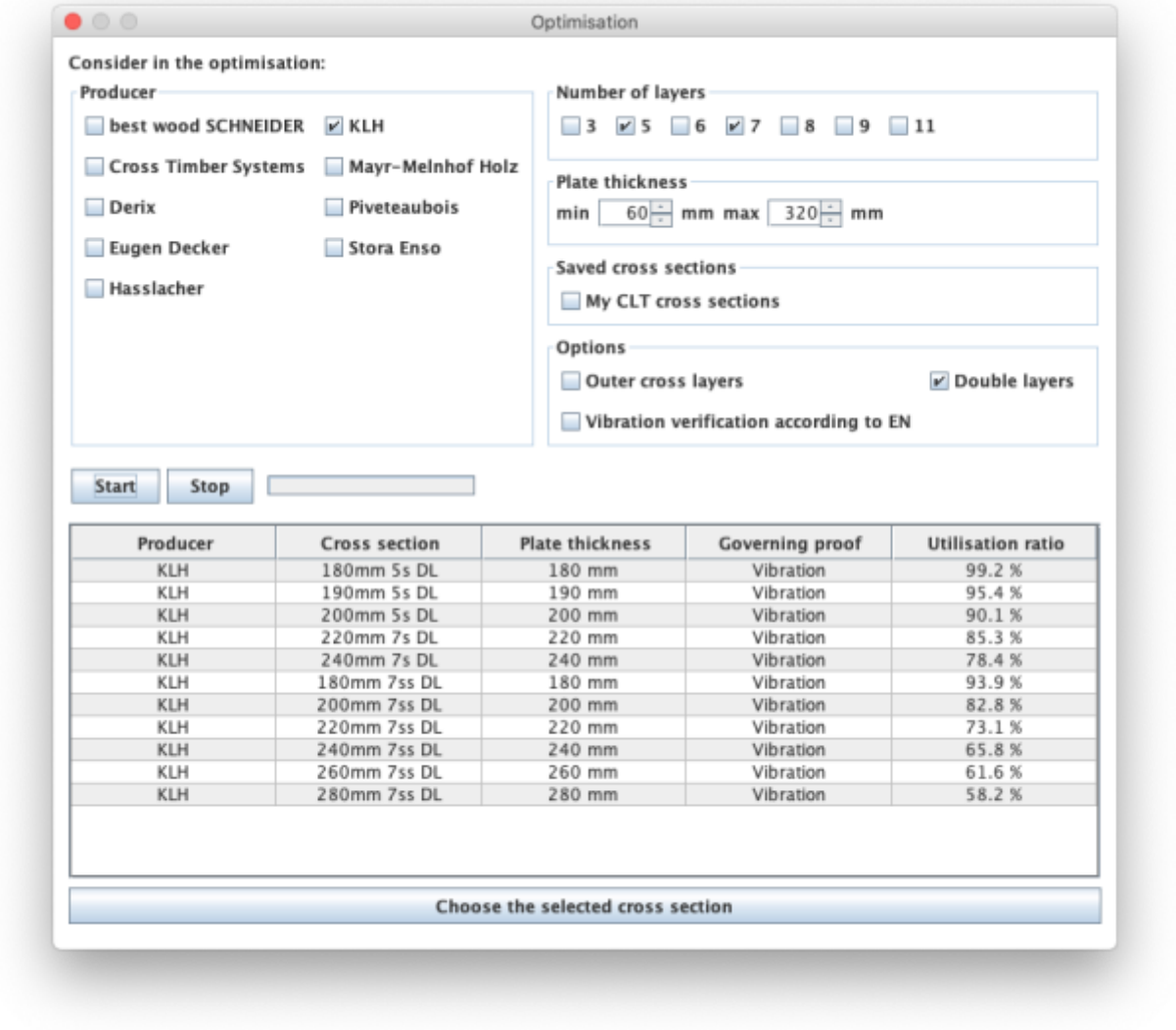
The user-defined materials are then displayed in the material selection list.



Optimization of layup

Use the button 

to display the window for layup optimization.



With the help of this tool, the possible layups can be determined for the given system and load situation. The optimization can be restricted with regard to producers, number of layers or by means of limits for the panel thickness. Furthermore, outer cross layers or double layers can be included or excluded. With the option "Vibration verification according to EN" the base document is included in the vibration check or not.

With the buttons "Start" and "Stop" the calculation is controlled. Please be patient, depending on the selected parameter the calculation may take a little longer.

The possible setups are then displayed in the table and the selected setup can be transferred to the main window by clicking the "Choose the selected cross section" button.

Cross section · 2017/11/14 17:11

Results and Output

Stiffness matrix

Determination and description of the single components

Bending and torsion

D_{11}	3,526,400	N·m	D_{12}	0	N·m	D_{13}	0	N·m
			D_{22}	433,067	N·m	D_{23}	0	N·m
						D_{33}	144,492	N·m

Shear for CLT-plate loaded out-of-plane

D_{44}	24,272,685	N/m	D_{45}	0	N/m
			D_{55}	6,706,029	N/m

In-plane Stiffness values

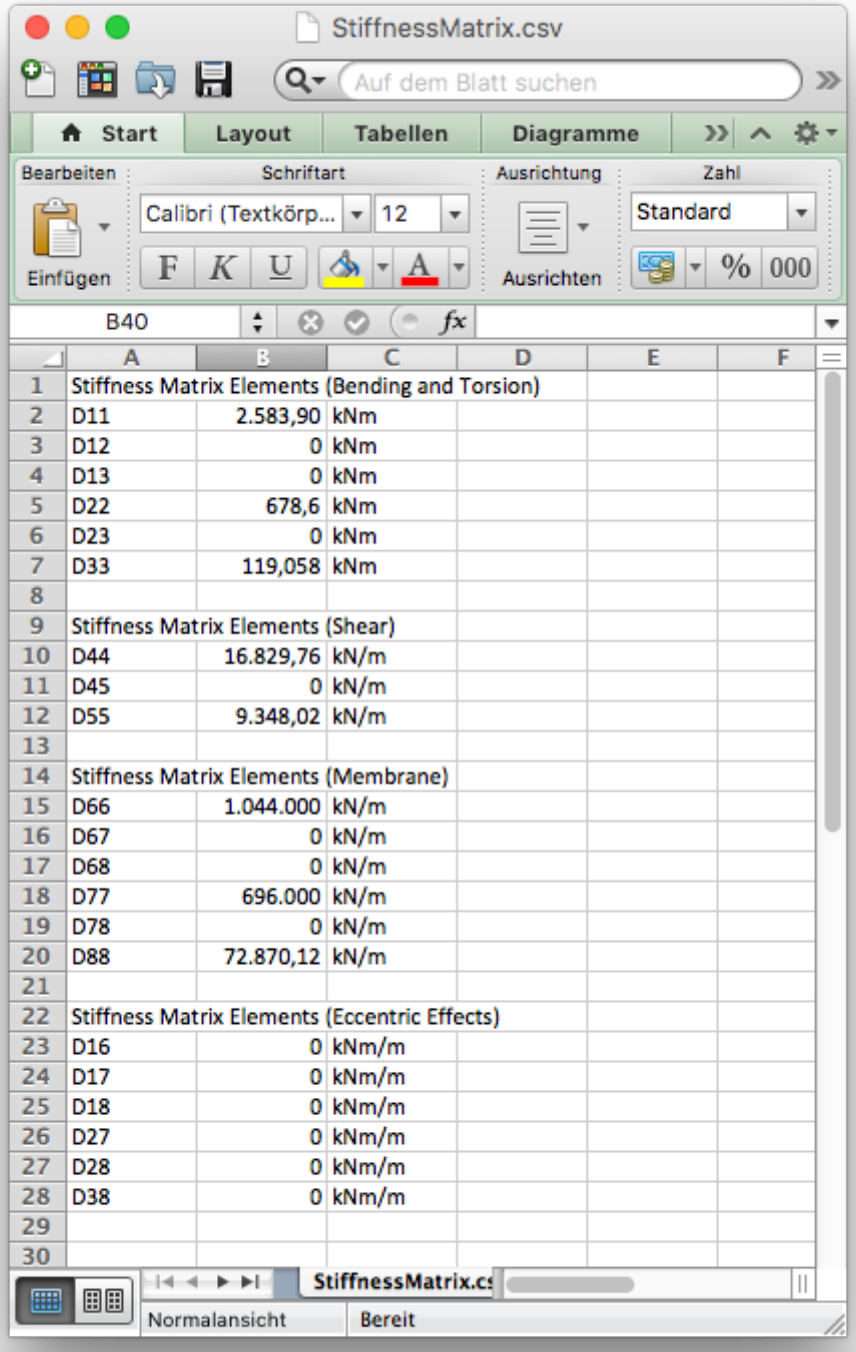
D_{66}	1,392,000,000	N/m	D_{67}	0	N/m	D_{68}	0	N/m
			D_{77}	464,000,000	N/m	D_{78}	0	N/m
						D_{88}	77,728,132	N/m

Eccentric effects

D_{16}	0	N	D_{17}	0	N	D_{18}	0	N
sym.			D_{27}	0	N	D_{28}	0	N
sym.			sym.			D_{38}	0	N

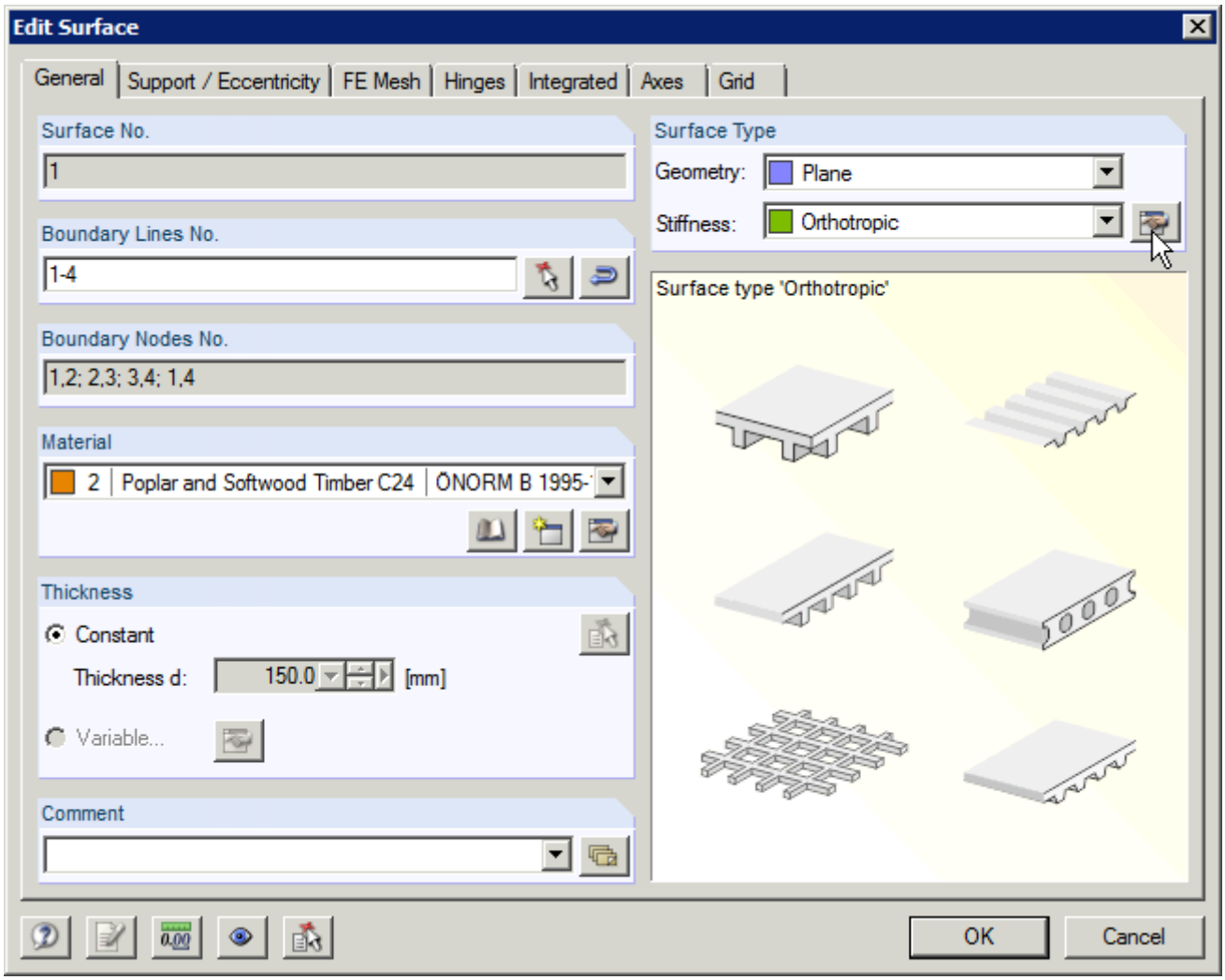
Export possibilities

By clicking on the button Export a csv file will be created, which contains the input data for RFEM 5.



	A	B	C	D	E	F
1	Stiffness Matrix Elements (Bending and Torsion)					
2	D11	2.583,90	kNm			
3	D12	0	kNm			
4	D13	0	kNm			
5	D22	678,6	kNm			
6	D23	0	kNm			
7	D33	119,058	kNm			
8						
9	Stiffness Matrix Elements (Shear)					
10	D44	16.829,76	kN/m			
11	D45	0	kN/m			
12	D55	9.348,02	kN/m			
13						
14	Stiffness Matrix Elements (Membrane)					
15	D66	1.044.000	kN/m			
16	D67	0	kN/m			
17	D68	0	kN/m			
18	D77	696.000	kN/m			
19	D78	0	kN/m			
20	D88	72.870,12	kN/m			
21						
22	Stiffness Matrix Elements (Eccentric Effects)					
23	D16	0	kNm/m			
24	D17	0	kNm/m			
25	D18	0	kNm/m			
26	D27	0	kNm/m			
27	D28	0	kNm/m			
28	D38	0	kNm/m			
29						
30						

The csv file can be imported into RFEM 5 via "Edit Surface" and the tab "Stiffness Matrix".


Edit Surface
General
Support / Eccentricity
FE Mesh
Hinges
Integrated
Axes
Grid
Surface No.
1
Boundary Lines No.
1-4
Boundary Nodes No.
1,2; 2,3; 3,4; 1,4
Material
2
Poplar and Softwood Timber C24
ÖNORM B 1995-
Thickness
Constant
Thickness d:
150.0
[mm]
Variable...
Comment
Surface Type
Geometry:
Plane
Stiffness:
Orthotropic
Surface type 'Orthotropic'
OK
Cancel