User guide for

AxisVM rapido 2

The application was developed for rapid and simplified structural design. Using this application doesn't mean that the design engineer has lower responsibility in design. Users should always meet all design criteria and follow design rules and current national design codes.

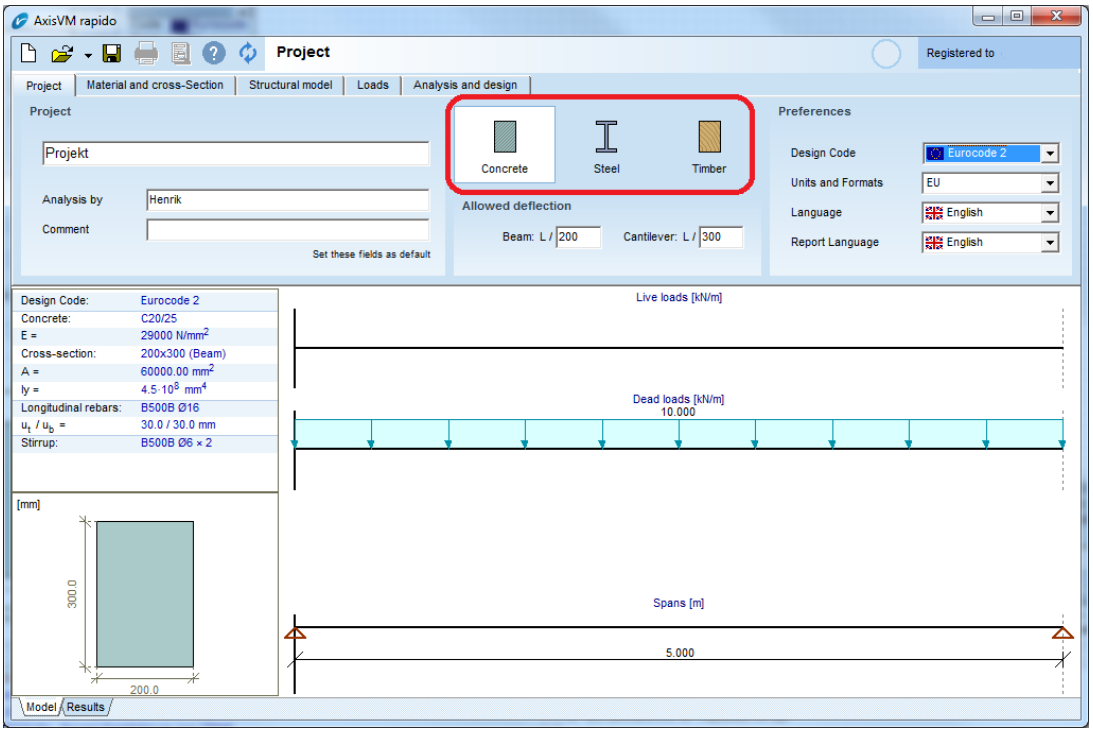
This page is intentionally left blank.

Contents

This page is intentionally left blank.

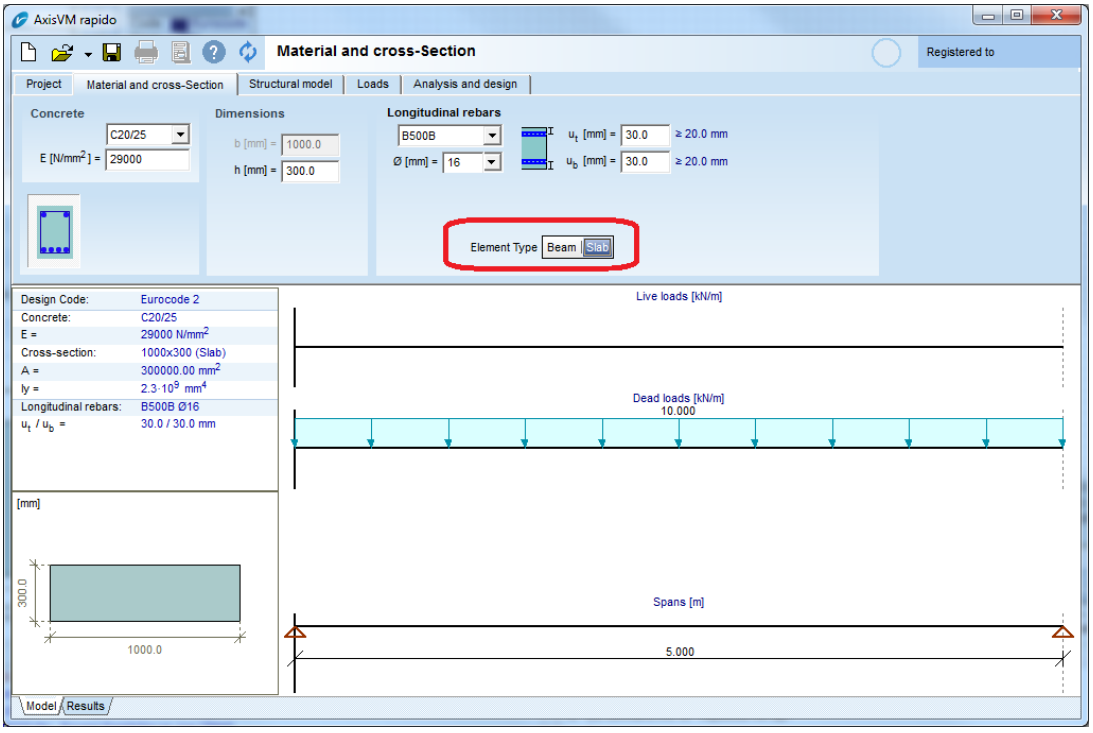
1. New Features of Rapido Beam 2

New speed buttons for materials



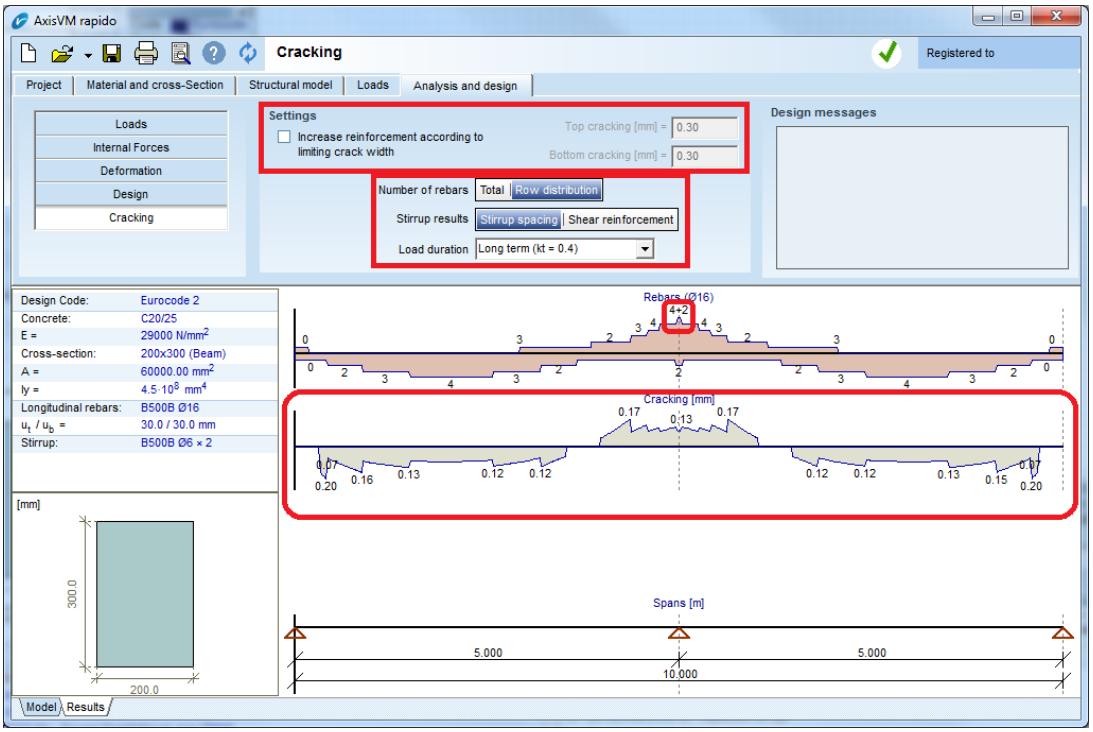
Using these new buttons user can very quickly define beam material.

Slab definition



By setting RC member element type as slab user can do design without shear reinforcement. Longitudal reinforcement will be increased to meet shear check criteria.

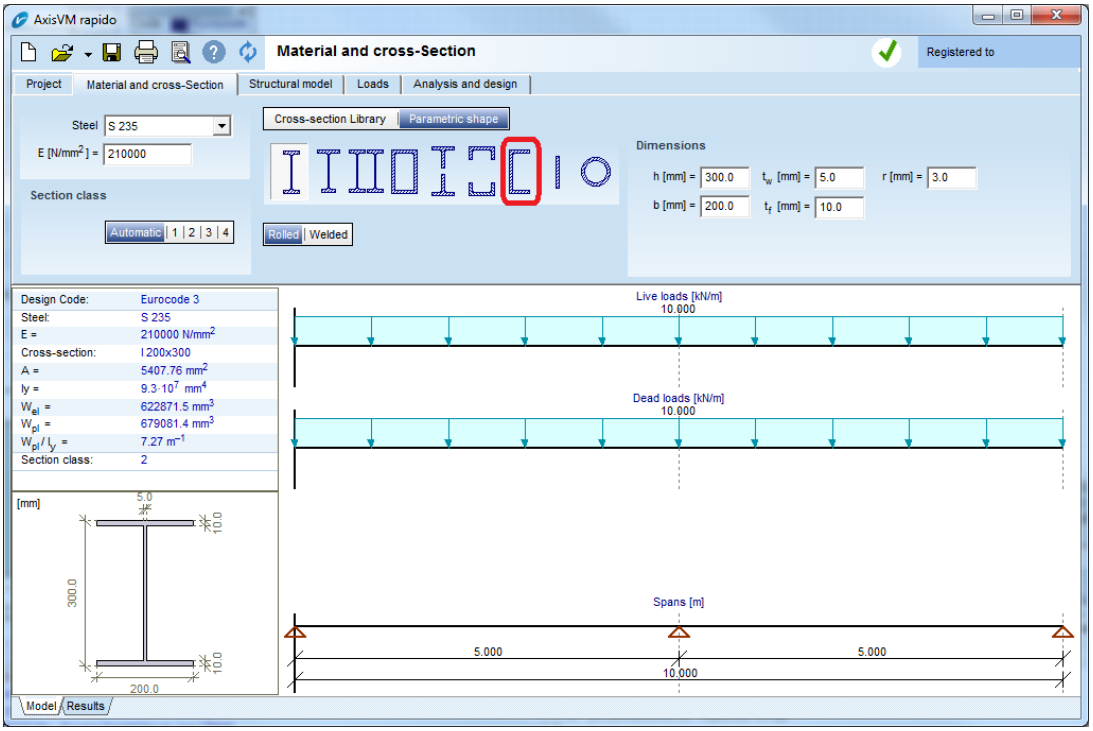
Crack widths and more design parameters



New diagram with crack widths and number of rebars shown as per row.
E.g. 4+2 on top denotes 6 bars arranged into 2 rows where 4 bars are in first outer row and 2 are in second outer row (row numbers always start from outer edge).
User can can set max. crack widths and program will increase reinforcement to control crack widths.
New design parameter: Load duration.
More design output settings:

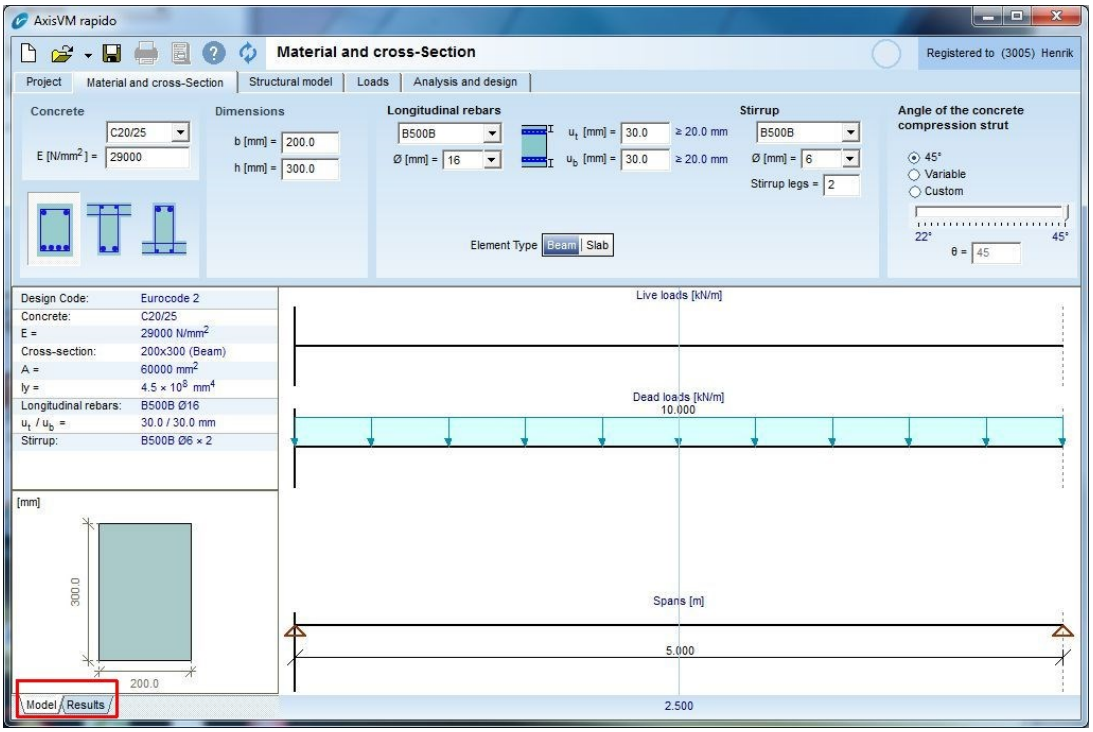
- total number of rebars or distributed in rows
- Stirrup spacing or shear reinforcement area

New steel cross-section shape



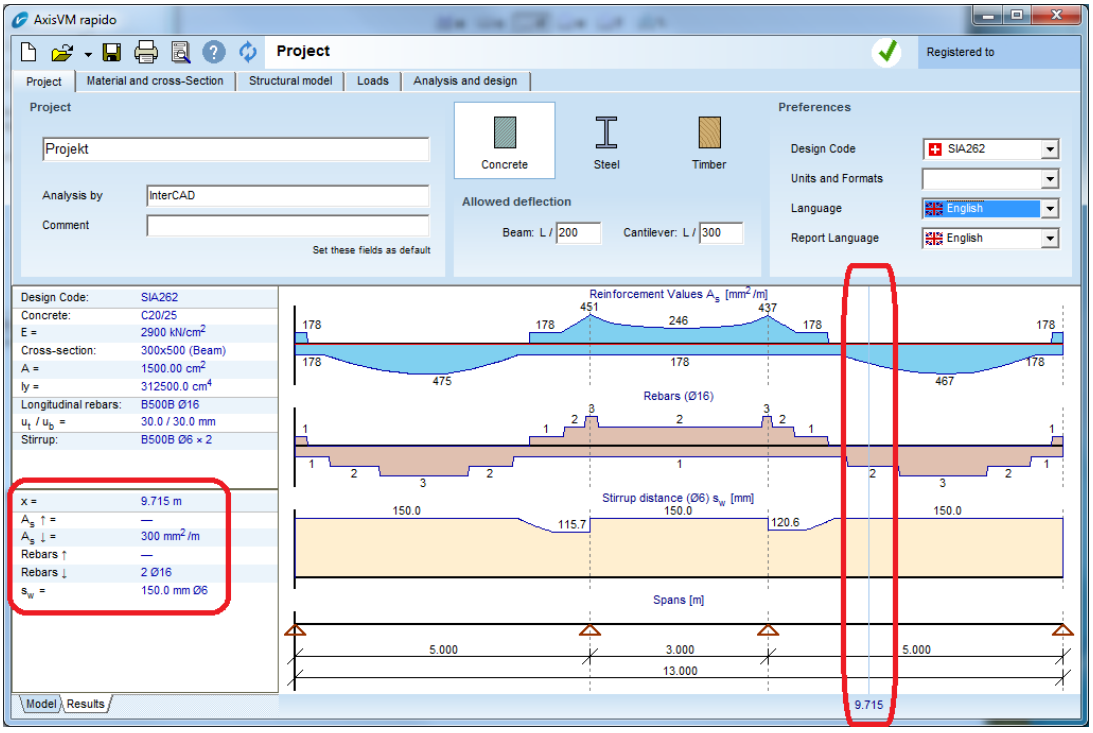
New cross-section shape can de added from database or defined parametrically.

New Model/ Results tab switch



If Results tab is activated all changes will be recalculated immediatelly. No need to click to Analysis and design tab.

New sliding results reader



Move the results reading slider to show the design results at that location in the bottom left corner.

This page is intentionally left blank.

2. Using Rapido Beam

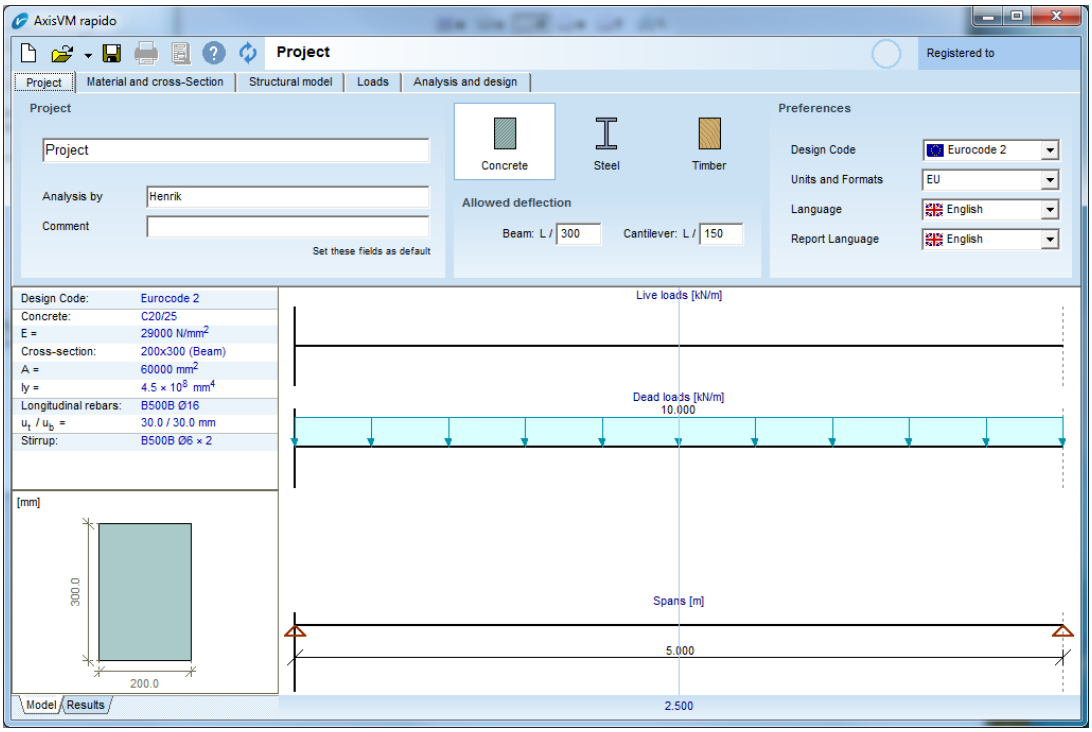
Application

Rapido Beam program is new and effective tool for design and check on multi-span reinforced concrete, steel or timber beams in plane.

Rapido Beam not only shows deformations, diagrams and reaction, it also performs all required design checks. While designing RC beams we get number of rebar sizes, link distances and crack widths. When steel or timber beams are designed we get utilisation factors. For simplified input only constant cross sections and loads in plane are accepted.

Using Rapido Beam is very simple. Input values are categorized into tabs and smartly arranged in lists. This way user can very quickly define beam sizes, add loads and read results.

Design progress



Steps of the design are as follow:

Project

This tab is for adding all informaton regarding the project (name, designer), basis settings (design codes, units, language) and service limit state limits (admissable deformations)

Material and Cross-section

Input values regarding used material and cross-section.

Structural model

Define spans and supports.

Loads

Define all vertical loads.

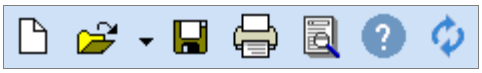
Analysis and design

Showing deflections, internal forces, reactions, required rebars and utilisation factors.

Report

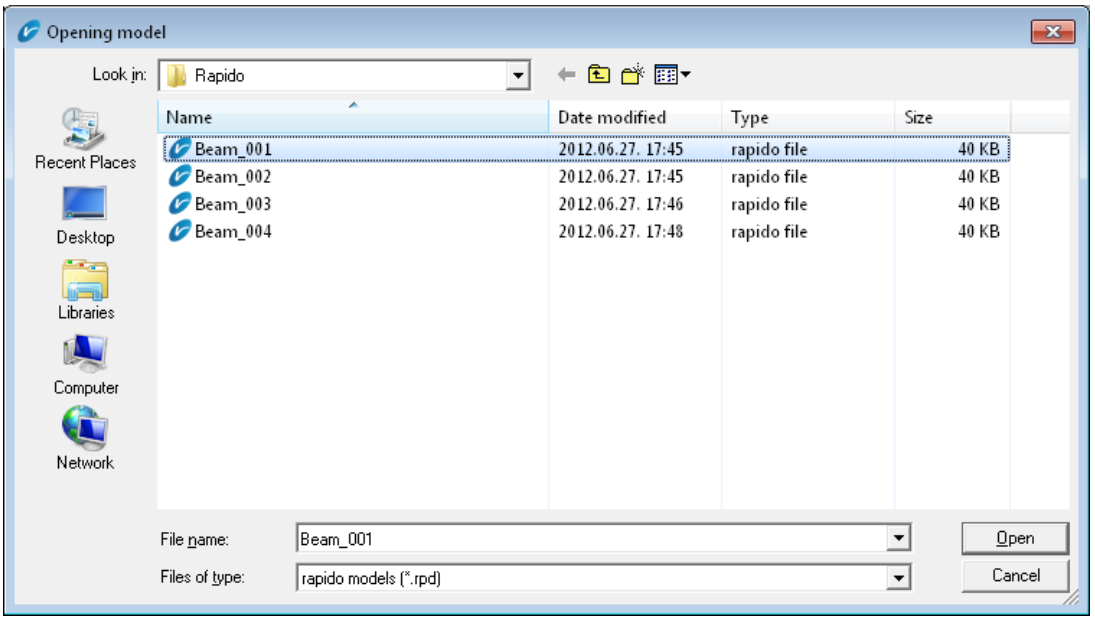
Printing results.

Rapido Beam doesn't have a menu, file operations and other functions are in one row of icons:

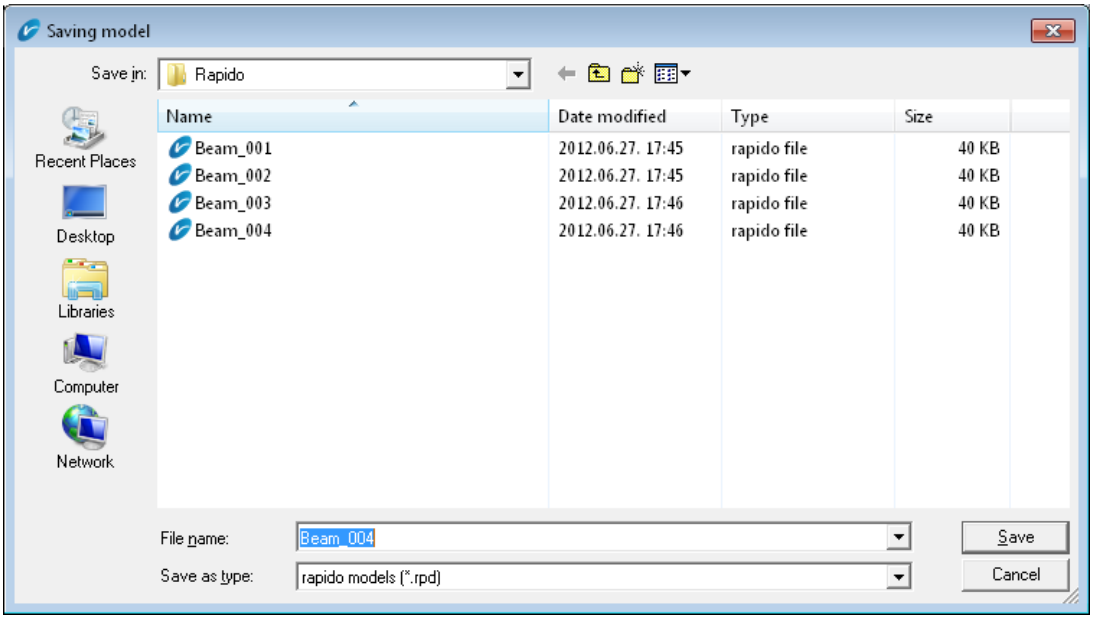


Create new file. Clicking on this icon opens „Project" tab.
See... Project

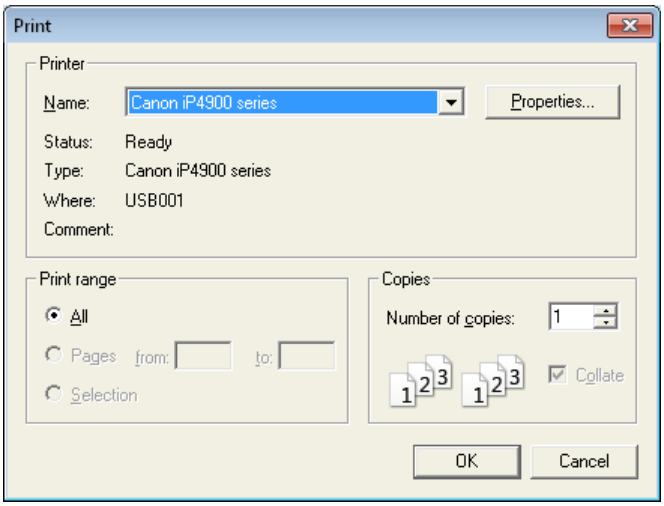
Opens Rapido Beam files. Clicking on „Open" icon shows dialog box. Clicking on the arrow next to this icon shows recently used files.



Saves everything to a Rapido Beam file.



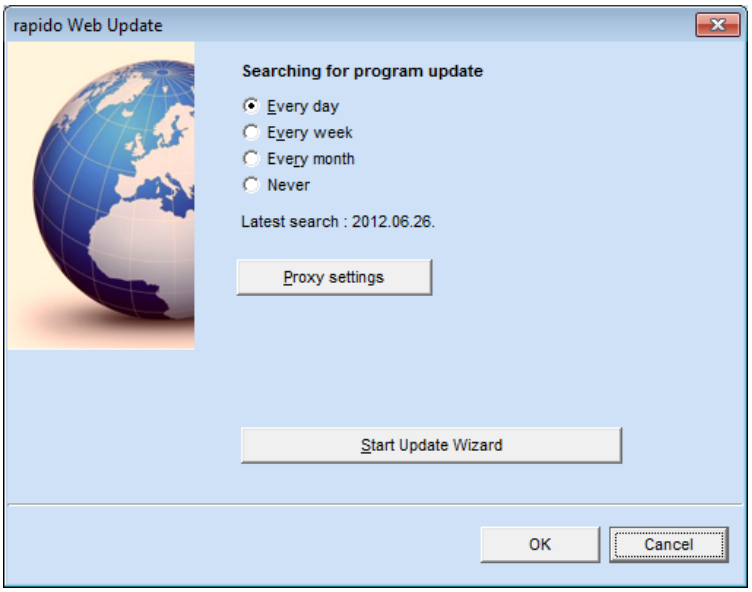
Prints report of the design.
This icon is activated when results are available. Clicking on this icon shows the standard printing dialog box with print settings.



Preview.
Entire report can be previewed and user can select which items of the report should be printed. **See...** Report generation

Help icon.
Opens user manual in pdf format. To open pdf files pdf reader must be installed (pdf readers: Adobe Reader, Foxit PDF Reader, etc.)

Rapido Beam automatic update settings.
Opens a dialog box with settings for Rapido Beam automatic updates.



Notification Icon.
Shows clear circle when results are not available. Turns to „checked" (green pipe), if beam meets all design criteria or red if beam fails.

This page is intentionally left blank.

3. Project

The following values can be added on this tab:

Project

Define name of the project, design engineer and description of the design (comments). This information will be in report's header.

Preferences

Select design code (EC, SIA) and type of material (reinforced concrete, steel, timber). Default materials according to selected type of material:

Steel:	S235,
Reinforced concrete:	C20/25
Timber:	C20

Select unit system for input and output values.
Select language used in application a report generation.

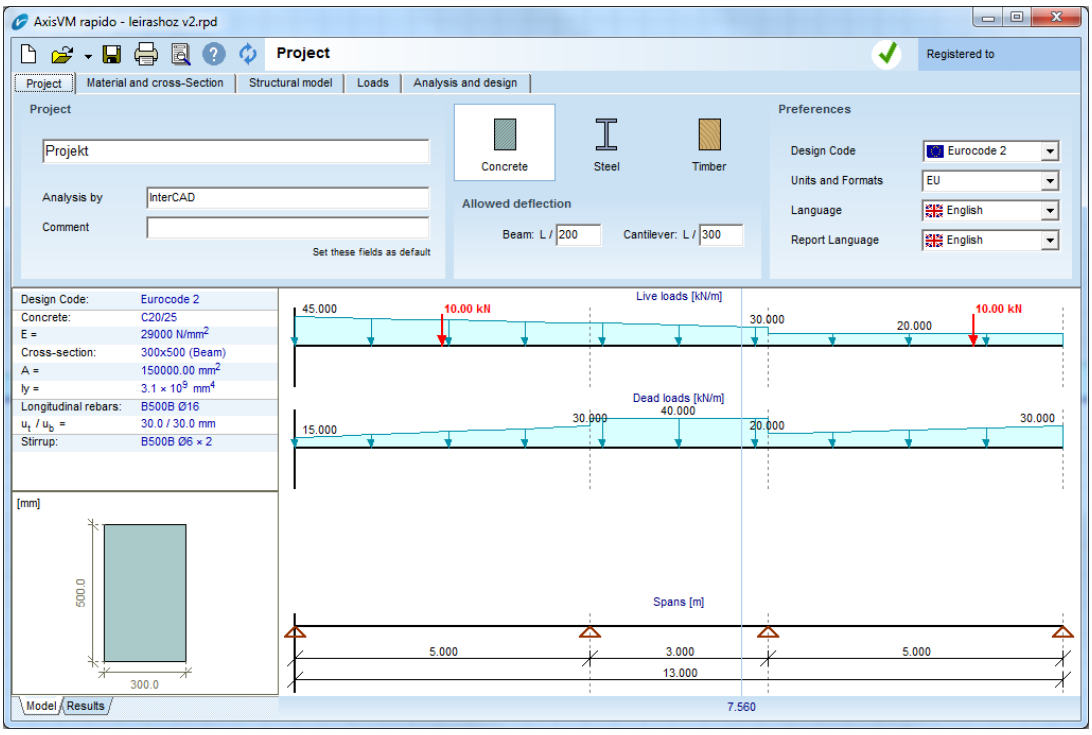
Admissible deformation

Can be defined on beams and cantilevers.

Input preview

This preview shows following information depending selected design code and material:

Value	*Steel*	*Reinforced concrete*	*Timber*
E	✓	✓	✓
Cross-section	✓	✓	✓
A	✓	✓	✓
Iy	✓	✓	✓
Service class			✓
K_{def}			✓
Longitudinal rebar		✓	
$U_a - U_f$		✓	
Stirrup distance		✓	
Stirrup leg		✓	
W_{el}	✓		
W_{pl}	✓		
Section class	✓		



This page is intentionally left blank.

4. Material and Cross-section

Steel design parameters

Following values can be defined for steel design:

Steel

Select grade of steel used in design.

E value

Elastic modulus of selected steel material, which can be modified (The modification is applied only to the current project)

Section class

Cross-sections are sorted into classes depending on their local behaviour of web or flanges:

Cross-section class 1
Those cross-sections which can form a plastic hinge with the rotation capacity required from plastic analysis without reduction of the resistance.

Cross-section class 2
Those cross-sections which can develop their plastic moment resistance, but have limited rotation capacity because of local buckling.

Cross-section class 3
Those cross-sections in which the stress in the extreme compression fibre of the steel member assuming an elastic distribution of stresses can reach the yield strength, but local buckling is liable to prevent development of the plastic moment resistance.

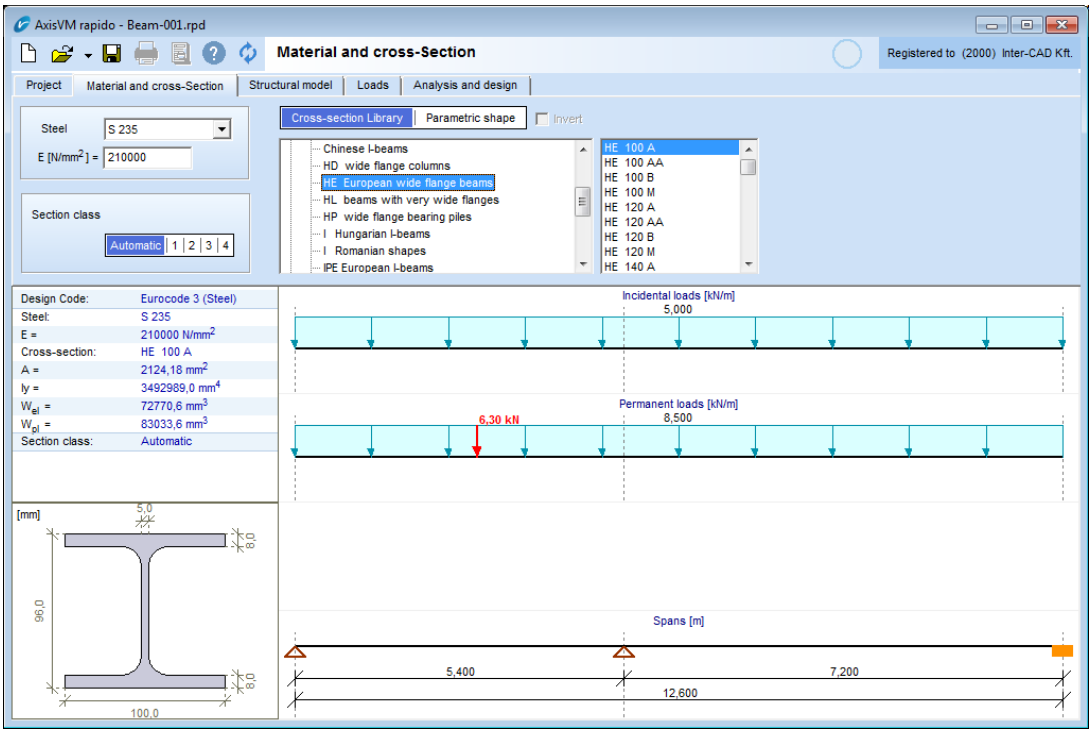
Cross-section class 4
Those cross-sections in which local buckling will occur before the attainment of yield stress in one or more parts of the cross-section.

Rapido can also automatically select the appropriate cross-section class and all design checks will be based on that. User can always select which class he wants to use in the design.
For example user can limit to elastic design by selecting class 3 for cross-sections with classes 1 or 2.

Define cross-section type

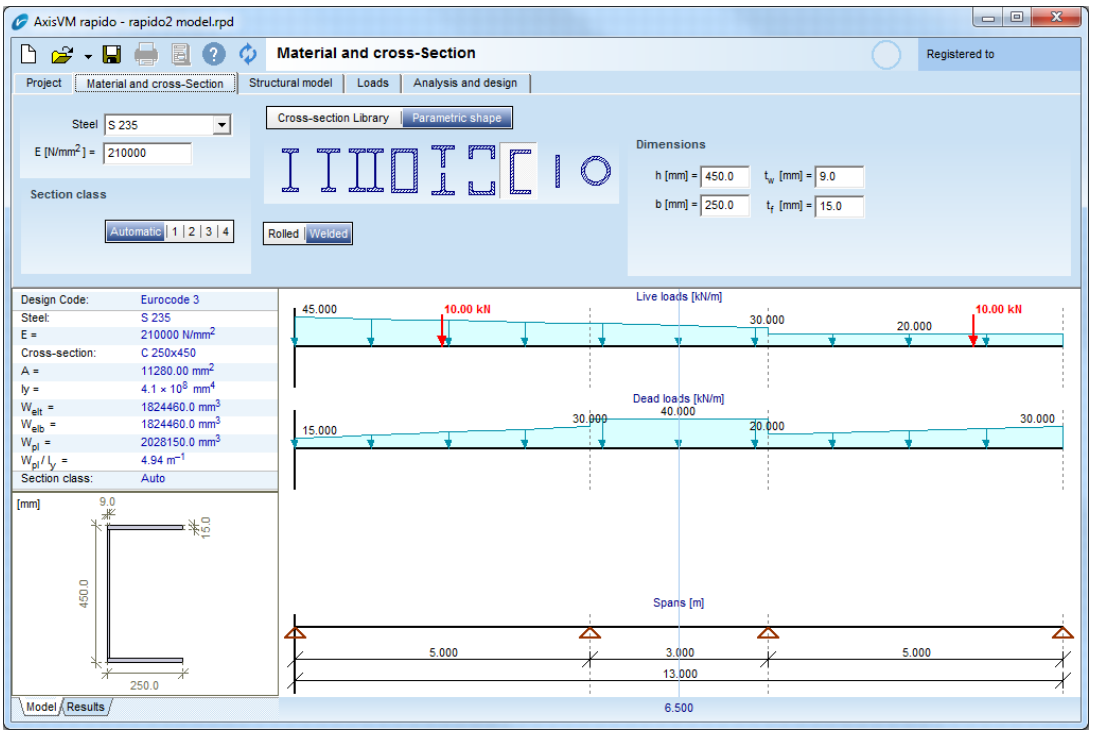
User can select from pre-defined cross-sections or create custom cross-section.

Cross-section Library



Cross-section can be selected from the two-part list. Left part of the list contains cross-section groups and the right part contains the particular cross-section.

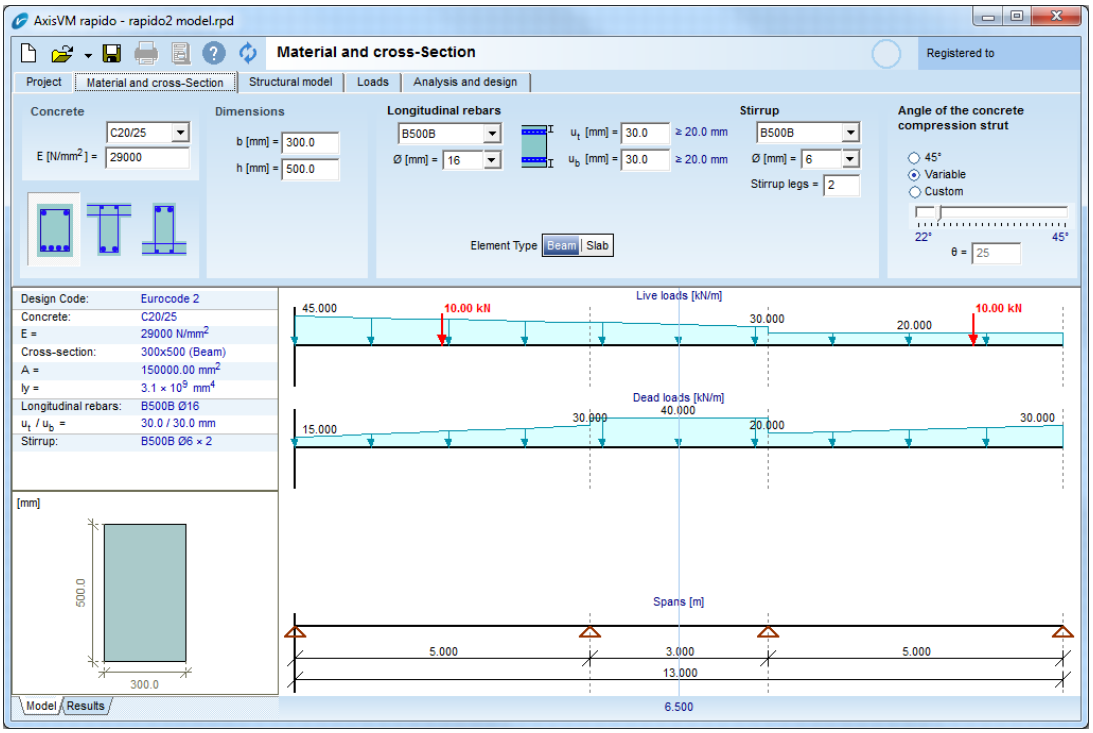
Parametric shape



Parametric cross-section is defined by specifying various parameters. User can also select the type of manufacturing type (rolled or welded) after selecting the basic shape. Finally cross-section's dimensions need to be filled: width, height and flange or wall thickness.

Concrete design parameters

Following parameters must be specified for concrete design:

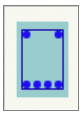


Concrete Select grade of concrete used in design.

E value Elastic modulus of selected concrete, which can be modified (The modification is applied only to the current project)

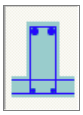
Cross-section types and dimensions

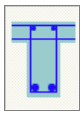
Rectangular



b: width
h: height

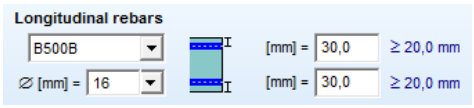
Upstand or downstand





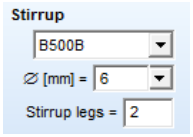
b: width
h: height
b_1: flange width
t: flange thickness

Longitudinal rebar



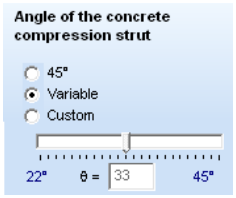
Define grade of reinforcement steel, diameter, and positions at top and bottom.

Stirrup



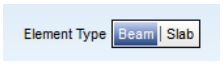
Define grade of reinforcement steel for stirrups, their diameter and number of legs.

Angle of the compression strut



Select what angle of the concrete strut should be used in the design checks. (The required shear reinforcement may vary significantly depending on what is selected here).

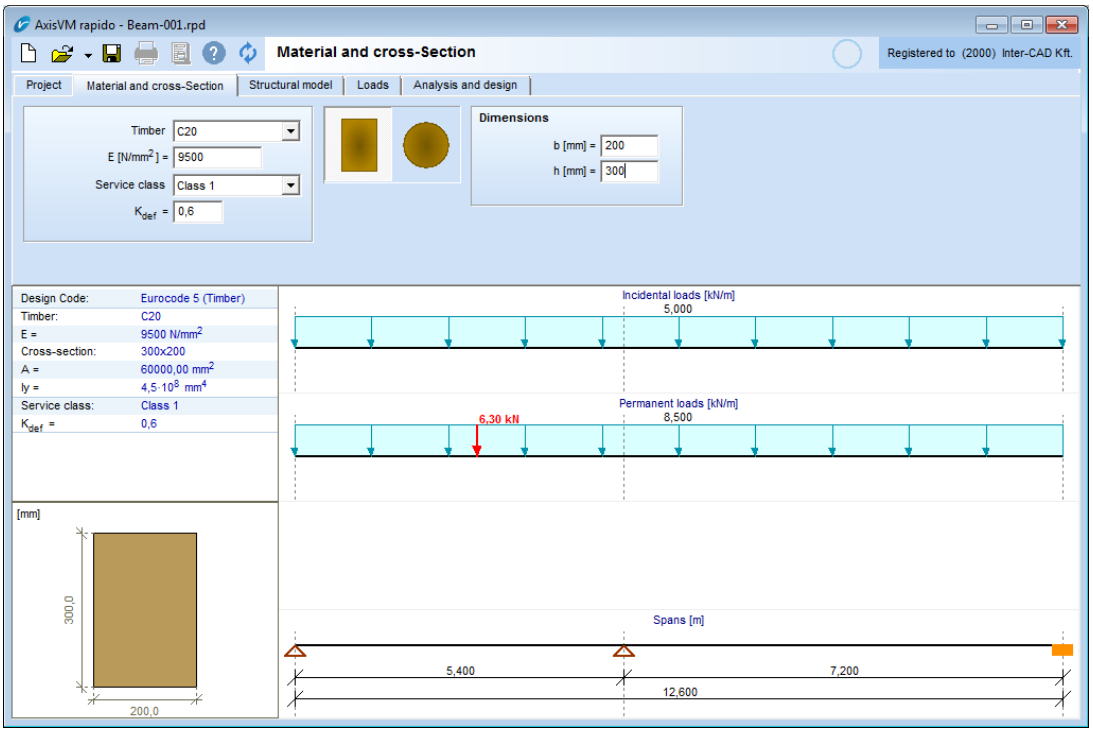
Element type



Select slab if you want to check it as rectangular section without shear stirrups. Longitudal rebar will be added to resist shear.

Timber design parameters

Following parameters must be specified for timber design:



Timber Select grade of concrete used in design.

E value Elastic modulus of selected timber, which can be modified (The modification is applied only to the current project)

Service class

Timber members should be assigned to one of these service classes.
Service classes for timber members are as follow(EN 1995-1-1, 2.3.1.3):
Service class 1 is characterised by a moisture content in the materials corresponding to a temperature of 20 °C and the relative humidity of the surrounding air only exceeding 65% for a few weeks per year.
Service class 2 is characterised by a moisture content in the materials corresponding to a temperature of 20 °C and the relative humidity of the surrounding air only exceeding 85% for a few weeks per year.
Service class 3 is characterised by climatic conditions leading to higher moisture contents than in service class 2.

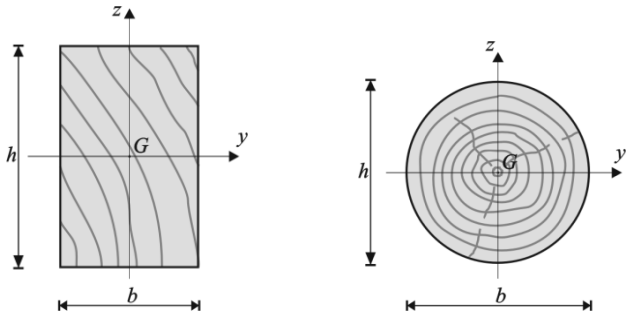
k_{def}

k_{def} factor is automatically set based on timber type and service class. (Table 3.2, EN 1995-1-1).

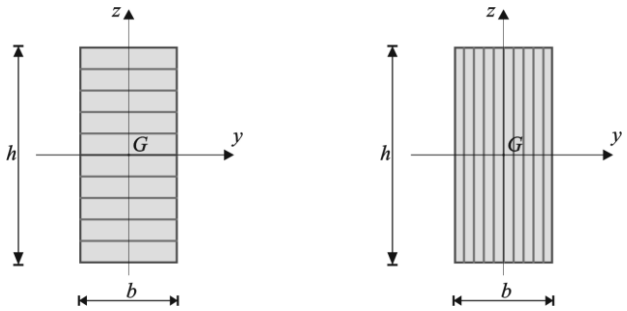
Cross-section

Rapido can be used for following cross-section and timber types:

1. Rectangle (solid, Glued laminated timber (Glulam), LVL, other)
2. Round (solid timber)



solid timber

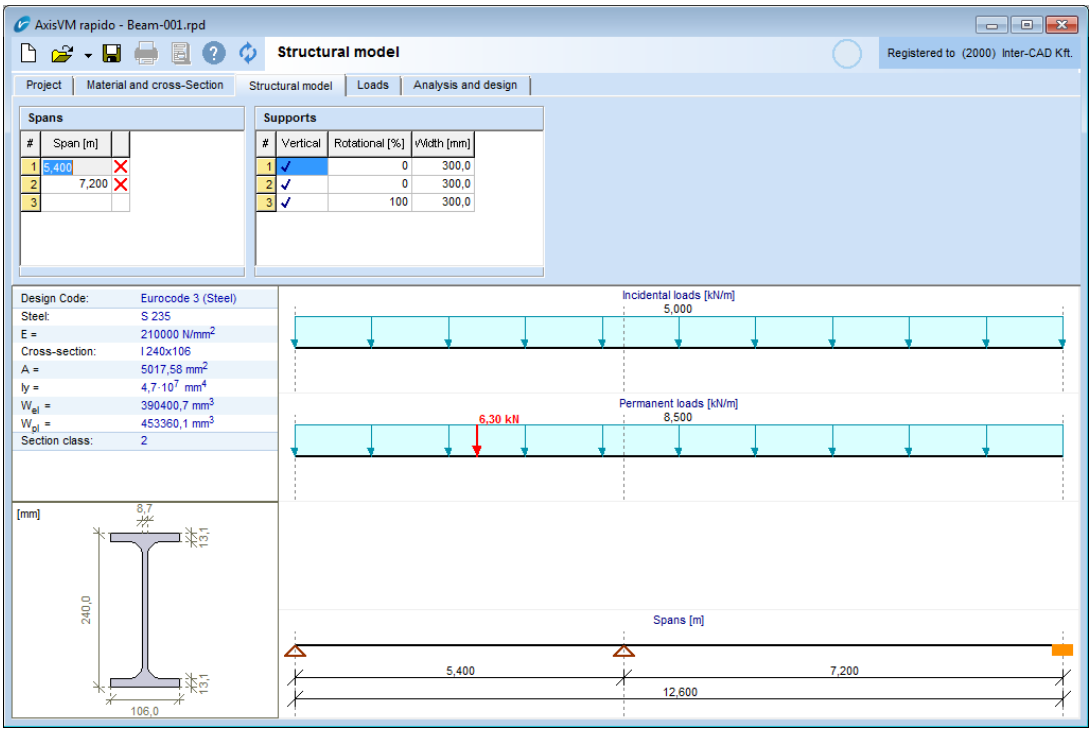


Glulam LVL

Dimensions

Rectangular cross-sections require width (b) and height (h). Round cross-sections require only radius (r).

5. Structural model



Spans

Beam spans can be defined in tables. Click on last empty row to define new support. To modify click on value you want to modify. To delete support click on red cross (X).

Supports

For defining supports three values are needed:

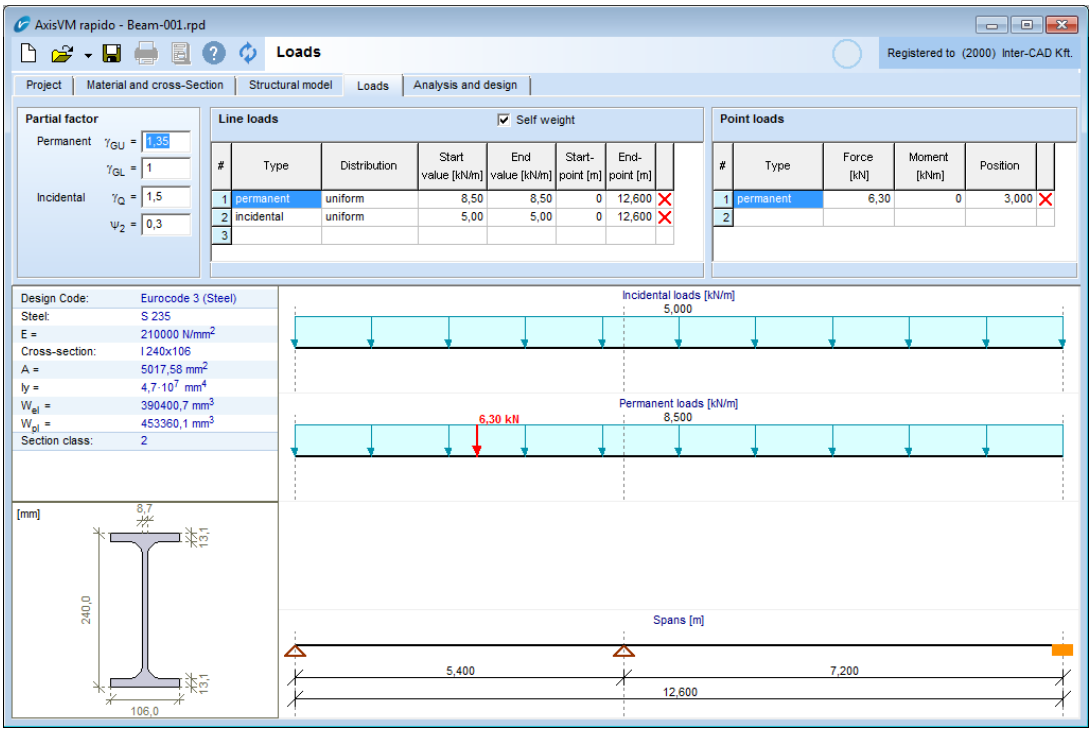
Vertical	Select this cell, if the support is also vertical (unselect for cantilevers)
Rotational [%]	Add rotational stiffness in percentage. 100% for fully fixed and 0% for pinned support.
Width	Specify width of the support. Default with is 30cm.

Supports shown as

	Vertical pinned support
	Vertical + partially fixed support (1-99 %)
	Fully fixed support (100 %)

This page is intentionally left blank.

6. Loads



User can specify permanent (dead) and incidental (live) loads on the beam. Permanent loads are always applied, whereas incidental loads are applied only when they act unfavourably. Incidental loads are automatically divided on spans, therefore no need to separate incidental loads manually on each span (pattern loading).

Partial factors

Set load factors for each load case and factor for quasi-permanent value of a variable action ψ_2.

Permanent

Permanent load's upper (γ_{GU}) and lower (γ_{GL}) factors.

Incidental

Incidental load's partial factor (γ_Q) and quasi-permanent value of a variable action (ψ_2)

Self-weight

Self-weight of the beam is added if selected to permanent loads.

Loads

Load values can be specified in the table.
For adding a new load click on last empty row of the table.
Click on the value to modify
Click on red cross X to delete the load

To define the load the following input values must be added:

Line load

Type	permanent or incidental
Distribution	uniform or trapezoid
Start value	load intensity at the beginning
End value	load intensity at the end
Start point	start point of the load from beam's start point
End point	end point of the load from beam's start point

Point load

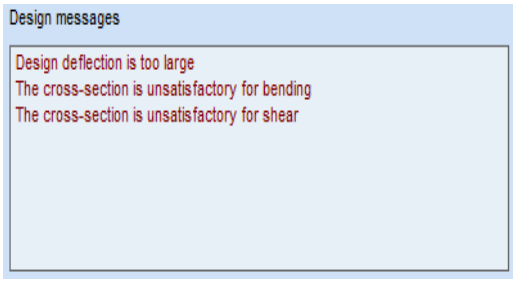
Type	permanent or incidental
Force	Vertical load's intensity (positive value for downwards direction)
Moment	Moment's intensity
Position	position of the point load from beam's start point

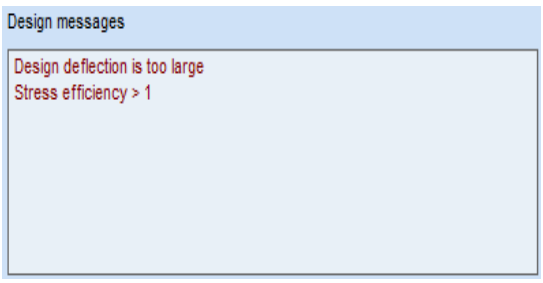
This page is intentionally left blank.

7. Analysis and design

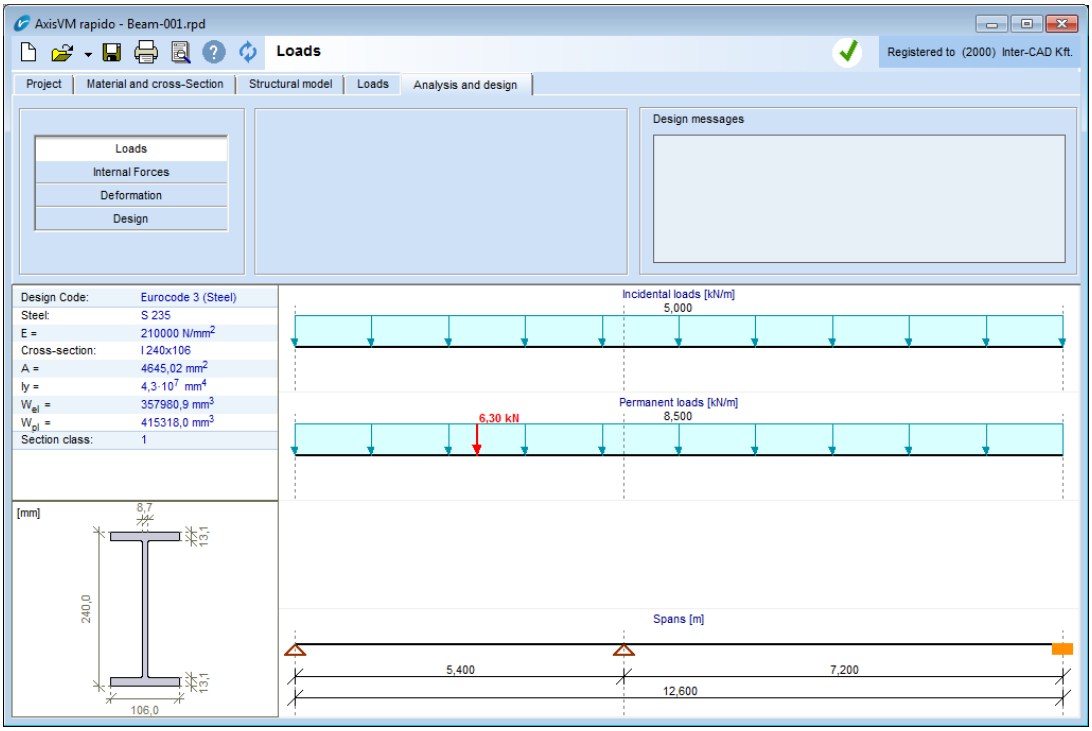
Analysis and design runs on a background by clicking on this tab.
If the beam design meets all design criteria's, then the information icon turns to .
If this icon shows then beam design fails and error message is shown in Design messages window.

Design messages



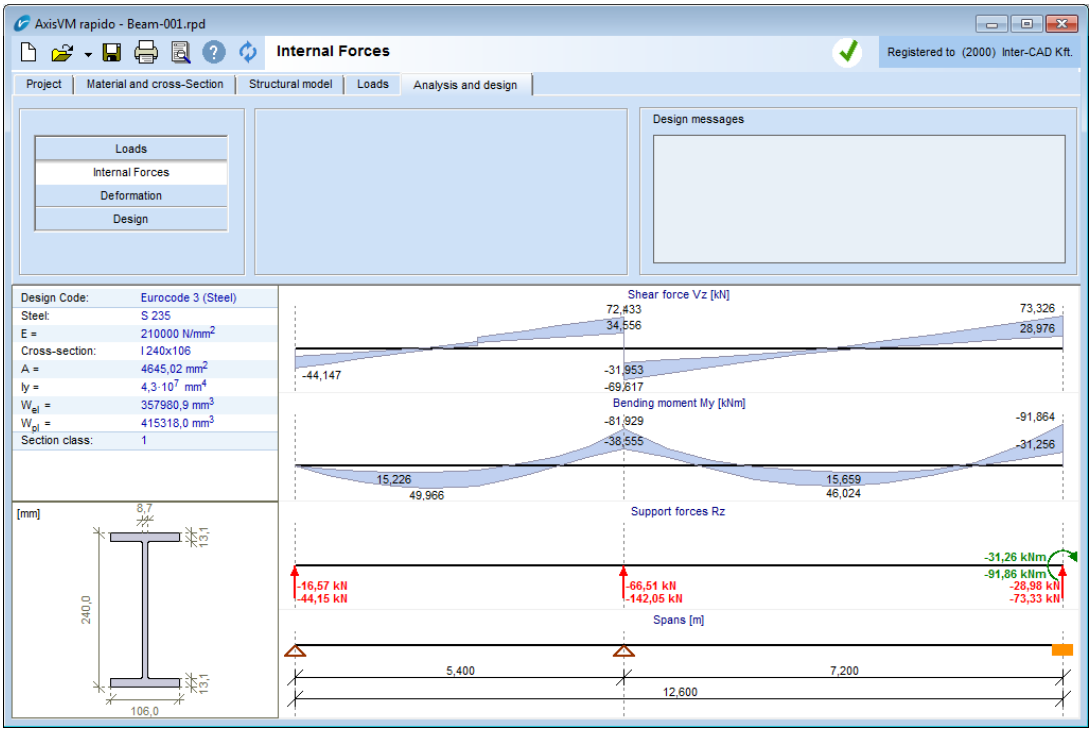


Loads



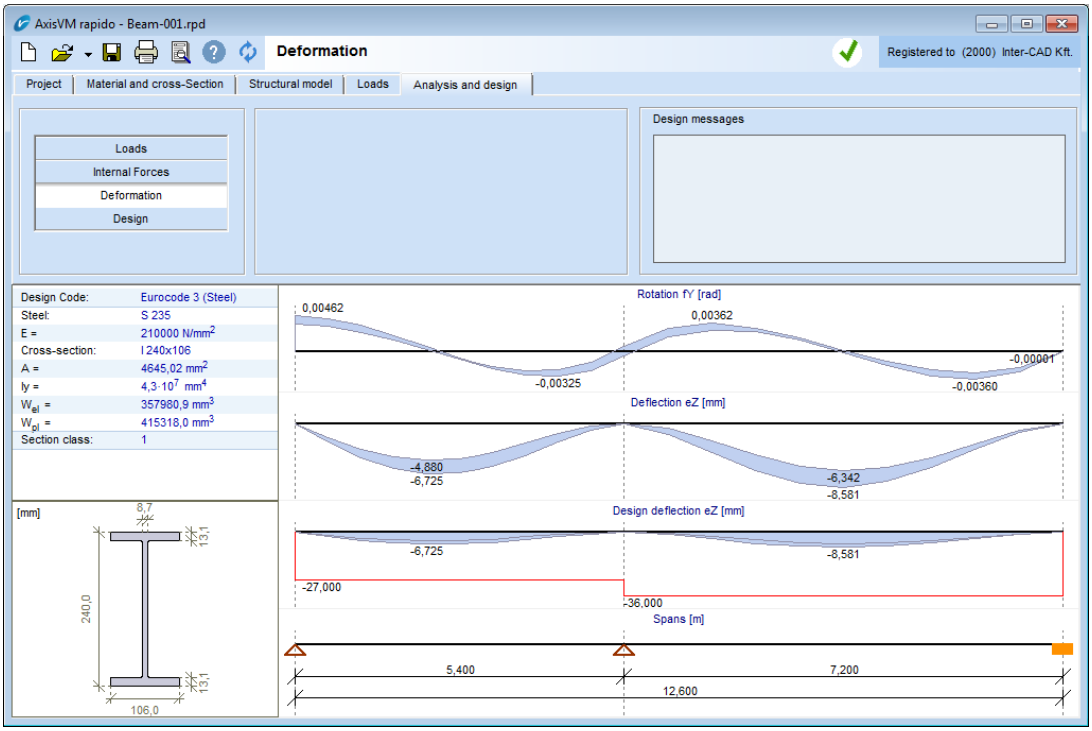
Loads defined on Loads tab are shown here.

Internal forces



Shows shear forces, moments about major axis and reactions. Application automatically calculates min. and max. envelope of all load combinations, hence always two overlapped diagrams are shown (min. and max. values) for each type of internal force.

Deformation



Shows rotations, and vertical deflection. Application automatically calculates min. and max. envelope of all load combinations, hence always two overlapped diagrams are shown (min. and max. values) for each type of deformation.
Diagram at the bottom (thin red line) shows max. allowed deflection which is specified on „Project“ tab.

Design

Steel beam

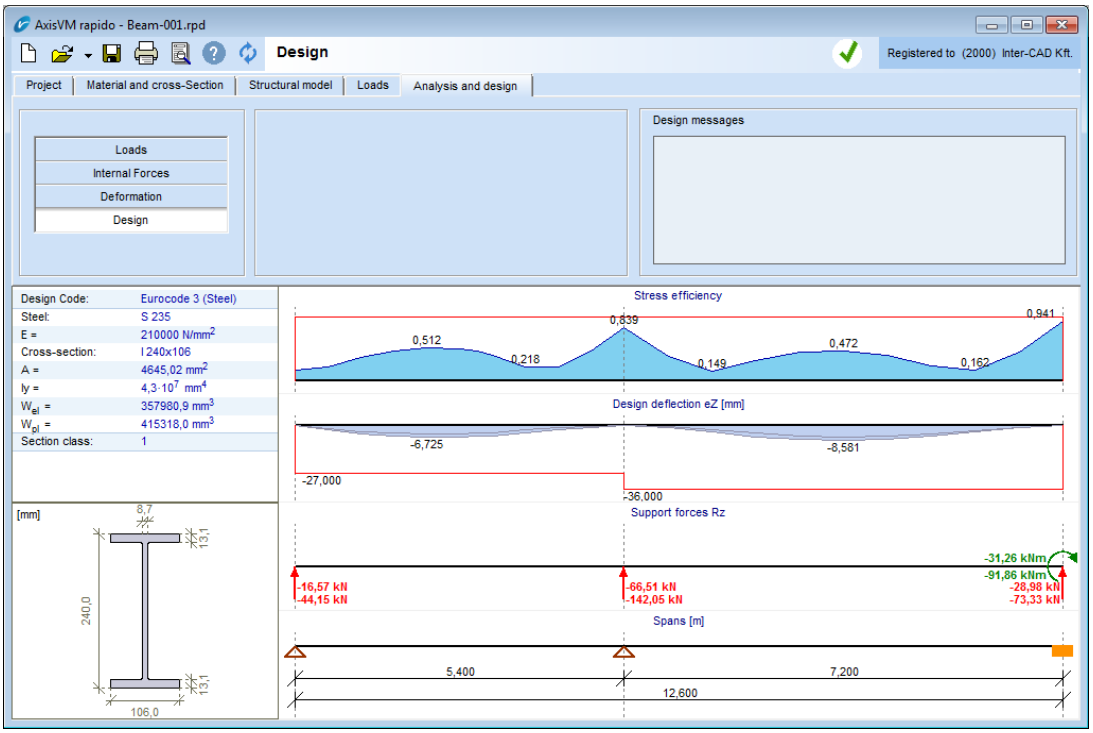
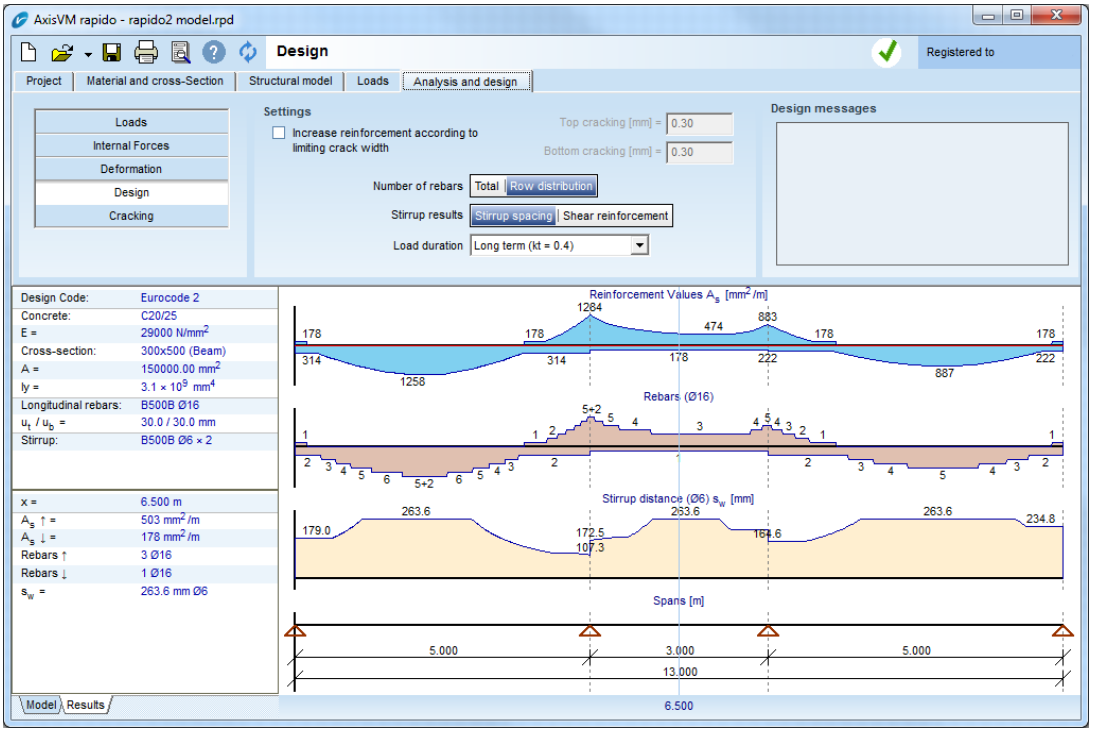


Diagram of elastic stress utilisations in the steel beam from envelope of load combinations. Rapido doesn't check web buckling and lateral torsional buckling. The thin red line denotes max. allowed deformations which is displayed together with max. vertical deformations (deflections).

Concrete beam



Shows area of required reinforcement from envelope of load combinations, together with number of bars (based on provided rebar diameters) on top and bottom. Third diagram from the top is showing the spacing of stirrups.

Increase reinforcement according to limiting crack width

If you check this option you can define max. crack width at top and bottom and rebar will be added to meet this criteria.

Number of rebars

Show total numbers of bars or bars per row separated with + sign. e.g: 5+2=7 bars, 5 in frst row and 2 in second row.

Stirrup results

Show spacing of defined stirrups or required area of shear reinforcement.

Load duration

Load duration used for crack width calculations, See formula 7.3.4.(2) in Eurocode. (only for Eurocode)

Timber beam

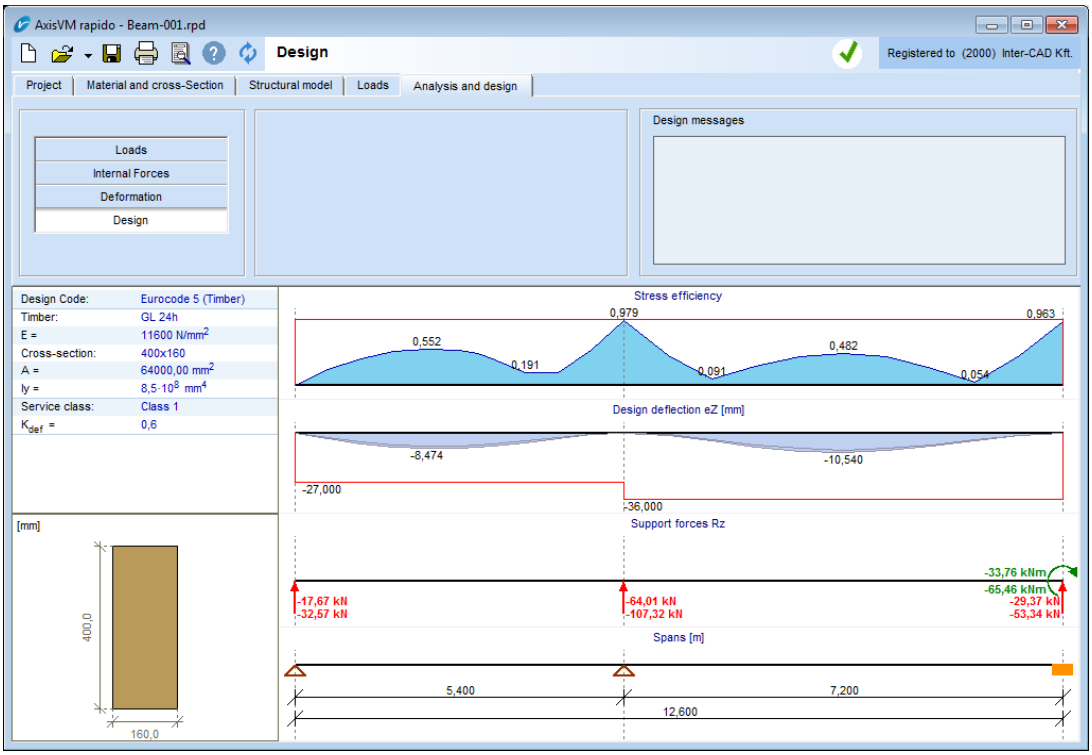


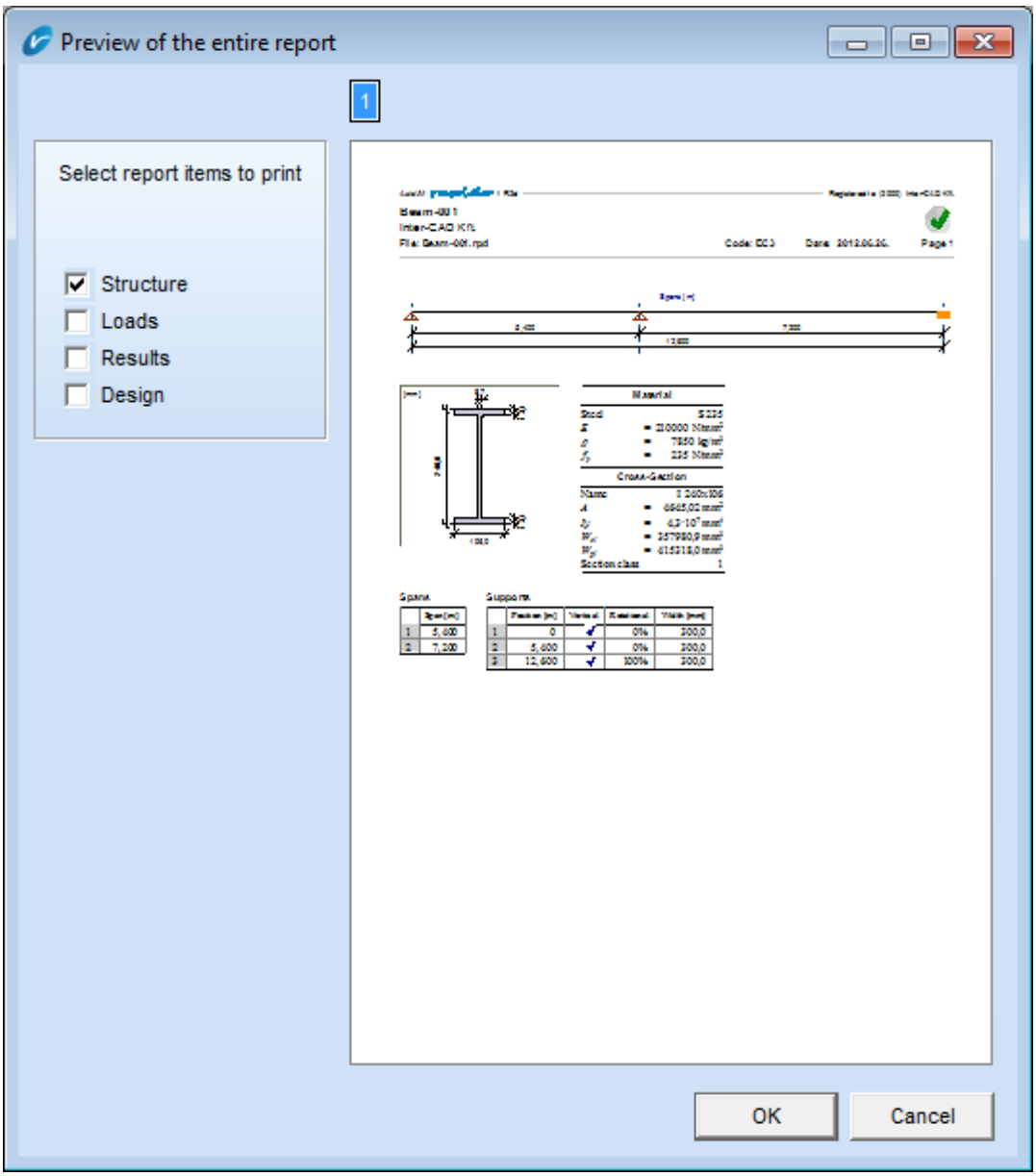
Diagram of elastic stress utilisations in the timber beam from envelope of load combinations. Rapido doesn't check lateral torsional buckling. Maximum deflections also shown together with limiting deflections (thin red line).

8. Report generation

Select what items should be in the report (structure, loads, results, design).
Click on report item to see the preview of selected report item.
The following output values are going into the report.

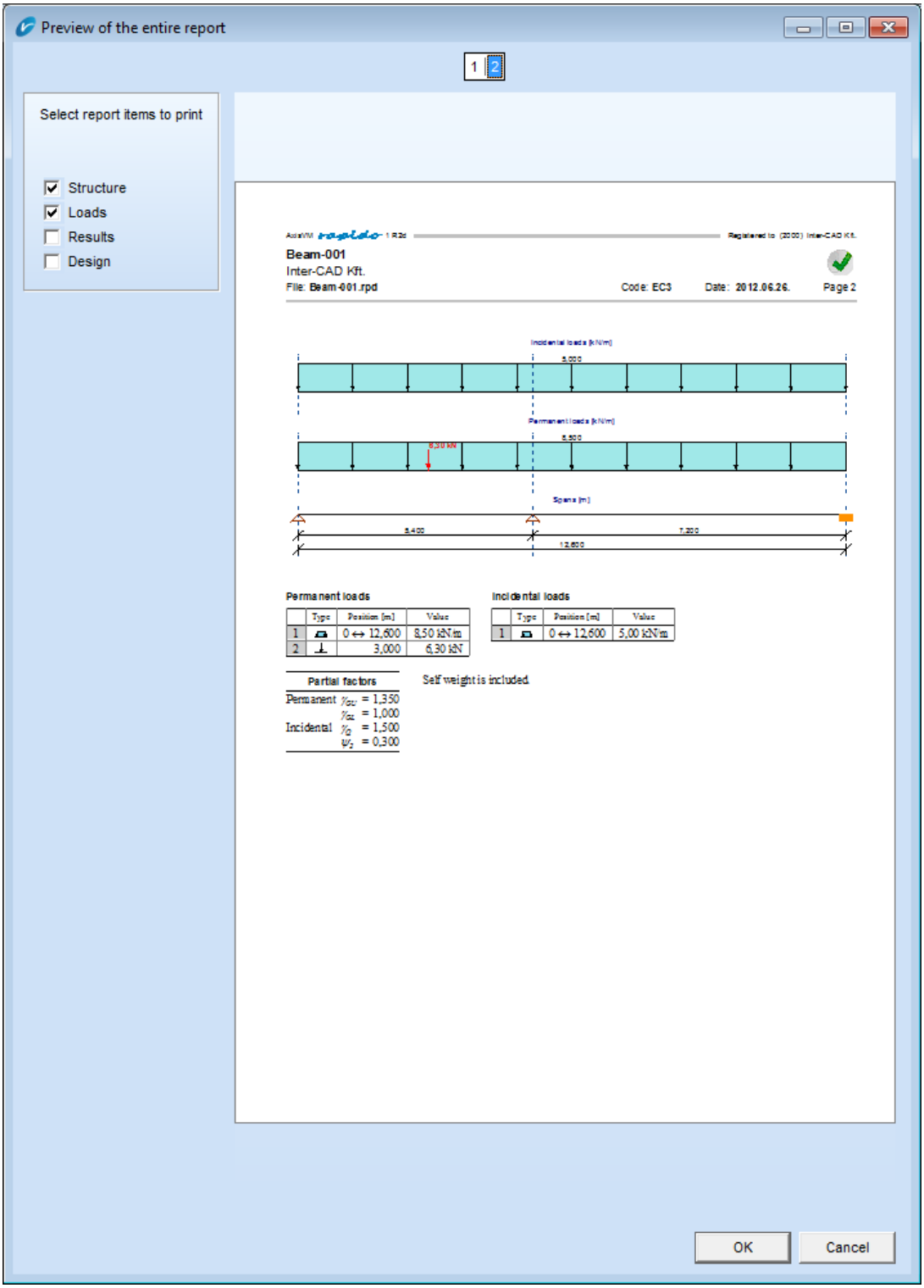
Structure

Showing beam in elevation, used material and cross-section, beam spans and types of supports.



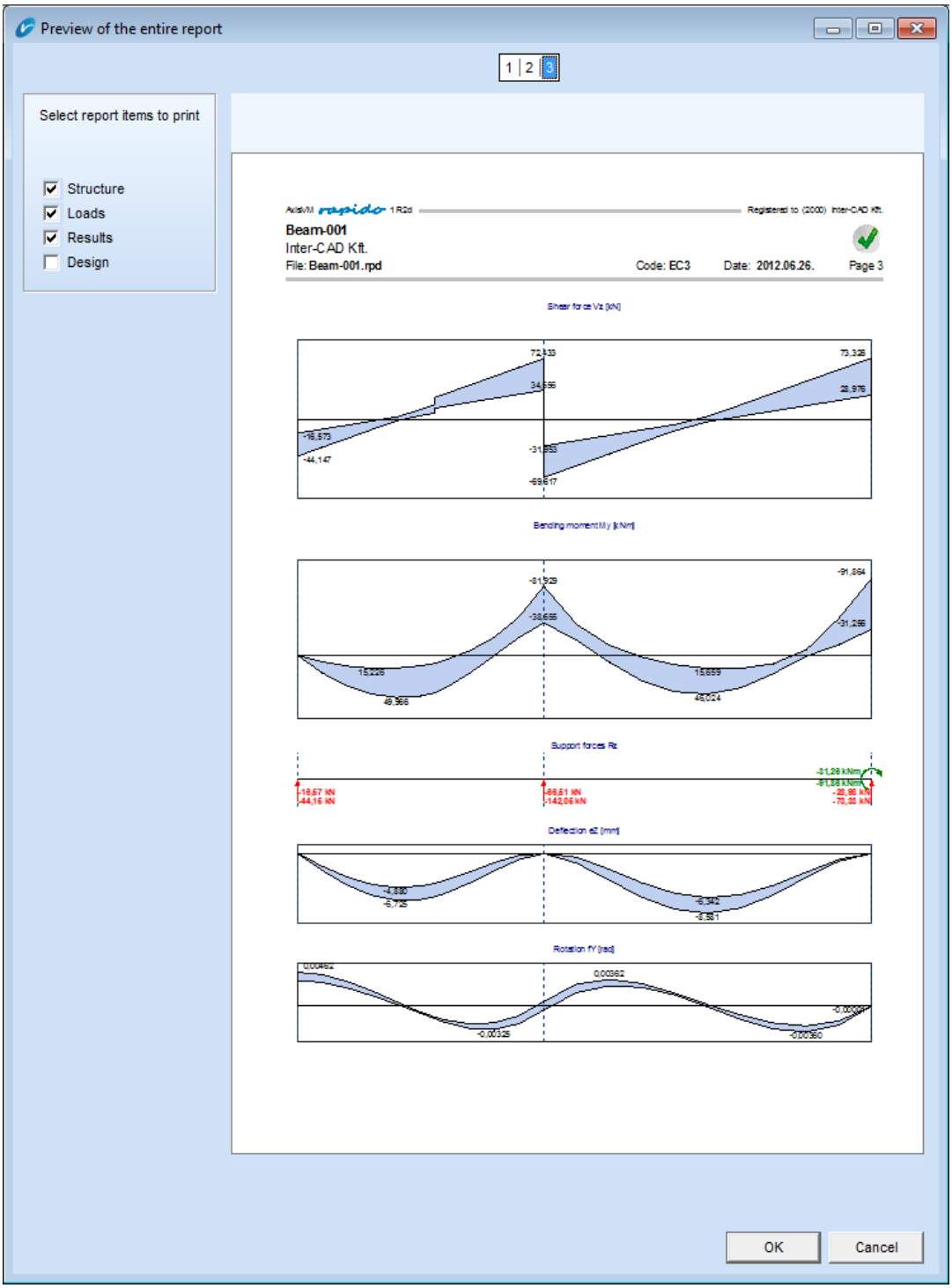
Loads

Showing permanent and incidental loads with their partial safety factors.



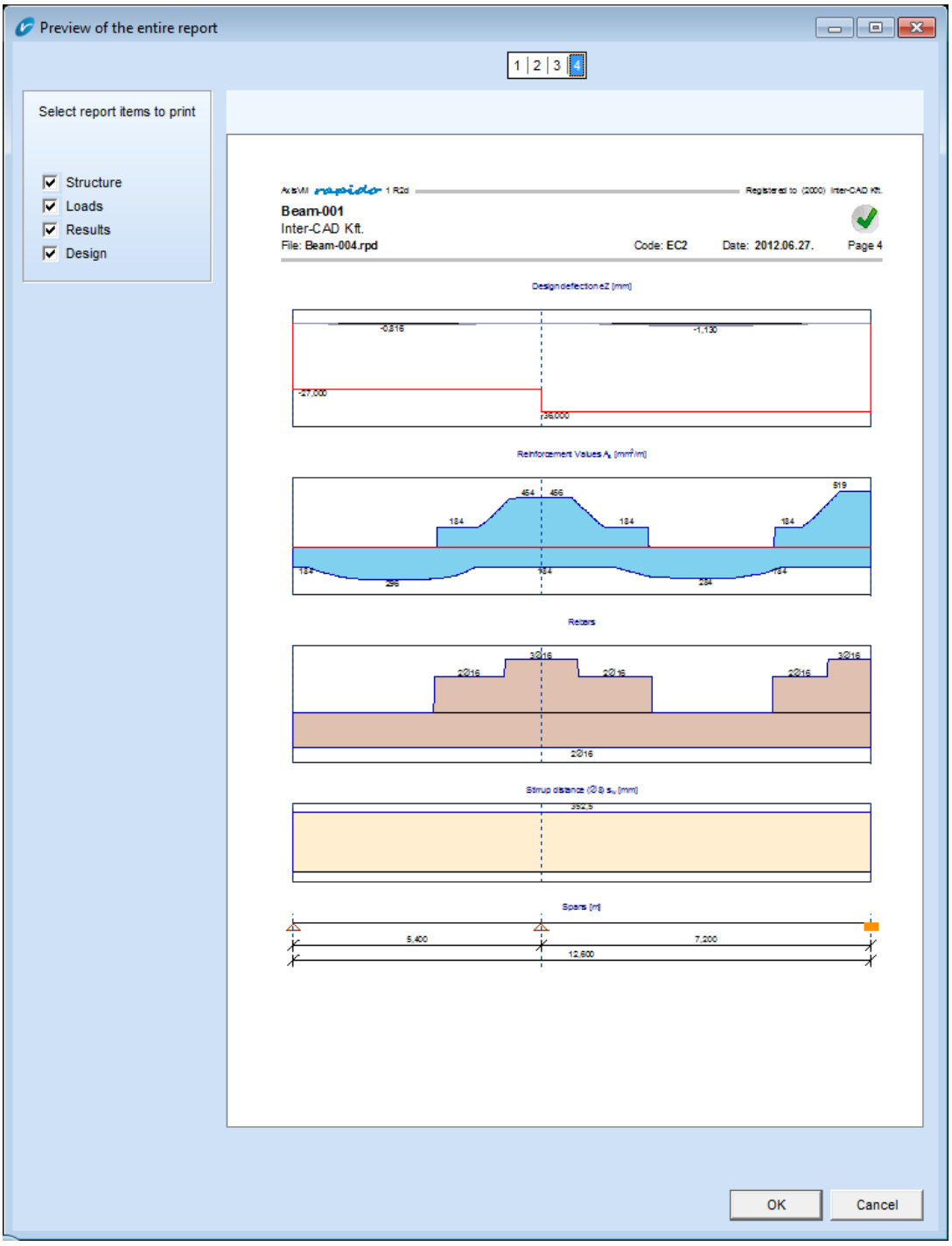
Results

Showing diagrams internal forces and deformations with min. and max. values..



Design

Showing diagram of max. stress utilisations or area of required reinforcement and spacing of stirrups for concrete beams.



Notes