User's Manual

BECA
Version 1.10.0

Civil engineering software
Beam deflection calculator for Windows

Windows XP® - Windows Vista® - Windows 7® - Windows 8® - Windows 10®

VAXA SOFTWARE

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Introduction

BECA - Beam deflection calculator is a Windows application to calculate deflection, slope, bending moment, shear force, and reactions of beams.

This manual isn't about beam deflection theory.

Please, read this manual carefully in order to learn all the capabilities of the application.

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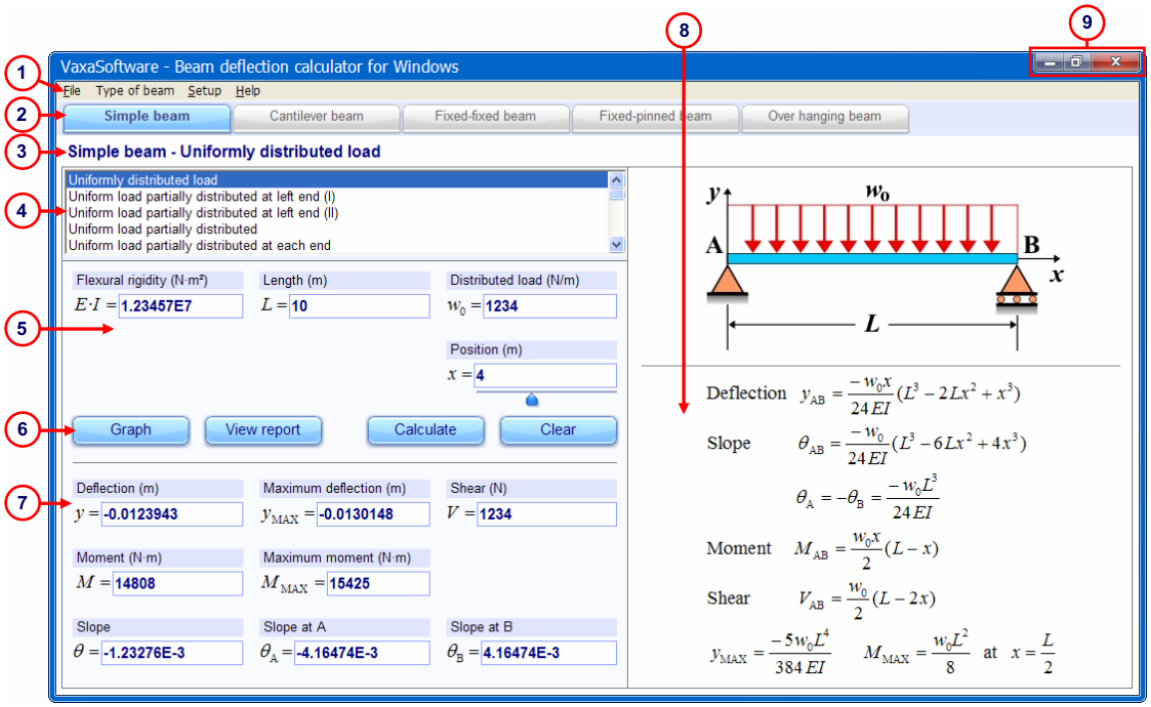
Main window



Main window

1 Menu bar

It contains the menus *File*, *Type of beam*, *Setup,* and *Help*.

File menu

Exit
Close the application.

Type of beam menu

- Simple beam
- Cantilever beam
- Fixed-Fixed beam
- Fixed-pinned beam
- Overhanging beam

Setup menu

Decimal separator:
We can select either point [.] or comma [,] as decimal separator.
The output values are shown using the selected decimal separator.

Significant digits
We can select between 4 and 12 significant digits for the output values.

Units
We can select units for length, deflection, force, distributed load, moment and flexural rigidiy:

Physical quantity	**Units**
Length, distance, position	m, cm, mm, µm, ft, in
Deflection, deformation	m, cm, mm, µm, ft, in
Force, load, shear, reaction	N, kN, MN, GN, kp (kgf), lbf
Distributed load	N/m, kN/m, MN/m, kp/m (kgf/m), lbf/ft, lbf/in
Couple moment, bending moment	N·m, kN·m, MN·m, kp·m (kgf·m), lbf·ft, lbf·in
Flexural rigidity	$N \cdot m^2$, $kN \cdot m^2$, $MN \cdot m^2$, $GN \cdot m^2$, $lbf \cdot in^2$, $ksi \cdot in^4$, $Pa \cdot m^4$, $kPa \cdot m^4$, $MPa \cdot m^4$, $GPa \cdot m^4$, $psi \cdot in^4$, $kp \cdot m^2$ ($kgf \cdot m^2$)

Help menu

User's manual (PDF document)...
Show this manual.

Application registration...
Show the registration form window to register the application.

Disabled functions in the unregistered version
Show the list of disabled functions when the application is not registered.

Home page (www.vaxasoftware.com)...
Connect to VaxaSoftware home page.
An active Internet connection and a browser are required.

About...
Show the *Splash* window with the version and description of the application.

2 **Type of beam** buttons

Allow us to select the type of beam.

- Simple beam
- Cantilever beam
- Fixed-fixed beam
- Fixed-pinned beam
- Over hanging beam

3 **Current beam/load** label

Shows the current beam and its load.

4 **Type of load** list

Allow us to select the type of load for the current beam.

5 **Input** textboxes

Allow us to enter the input values.

The numeric values can be entered in the following formats:

- Standard numbers: 0.24; 15.23
- Percentage: 90%; 12%
- Fractions: 2/3; 5/8
- Scientific notation: 2E-4 (equal to $2x10^{-4} = 0.0002$)

◆ **Note 1:**
Decimal separator:
We can use either point **.** or comma **,** as decimal separator. The output value is shown using the same decimal separator.

◆ **Note 2:**
Scientific notation:
The scientific notation is used to show very big or very small numbers.
A scientific notation number has a mantissa and a power of 10.
To enter a scientific notation number we use letter E to input the exponent of 10.

Examples:
5.67×10^{89} is entered as 5.67 E 89
1.23×10^{-34} is entered as 1.23 E-34

6 ***Calculate, Graph, Clear, and View report*** buttons

Calculate button
Calculate output values from input values.

Graph button
Show *Edit type of graphic* window.

Clear button
Clear all the input/output values.

View report button
Shows a detailed report for the input data with:

- Diagram of the beam and its load.
- Input data.
- Formulae.
- Graphs of deflection, slope, bending moment and shear force versus position "x".
- Data tables of deflection, slope, bending moment and shear force versus position "x".
- Maximum of deflection, slope, bending moment and shear force.
- Reaction force.
- Deflection, slope, bending moment and shear force for the current position "x".

7 **Output** textboxes

Shows the output values.

8 **Formulae** image

Shows the formulae of the current beam and its load.

9 **Window control** buttons

Minimize button
Minimize the application to an icon on the desktop.

Maximize / Restore button
Maximize / restore the application's window size.

Close button
Close the application. Also we can press Alt + F4 keys on our keyboard.

Types of beams and loads table

This application can perform 5 main types of beams.
Click on the appropriate *Type of beam* button to select a type of beam and then select the type of load in the *Type of load* list.

Simple beam

	Ref.
- Uniformly distributed load	100
- Uniform load partially distributed at left end (I)	101
- Uniform load partially distributed at left end (II)	102
- Uniform load partially distributed	103
- Uniform load partially distributed at each end	104
- Load increasing uniformly to right end	105
- Load increasing uniformly to center	106
- Sinusoidal distributed load	107
- Concentrated load at center	108
- Concentrated load at any point	109
- Two equal concentrated loads symmetrically placed	110
- Two equal concentrated loads unsymmetrically placed	111
- Two unequal concentrated loads unsymmetrically placed	112
- Couple moment Mo at right end	113
- Couple moment Mo at left end (I)	114
- Couple moment Mo at left end (II)	115
- Couple moment Mo at center	116
- Couple moment Mo at any point	117
- Couple moments M1 and M2 at each end (I)	118
- Couple moments M1 and M2 at each end (II)	119
- Two equal couple moments Mo at each end	120

Cantilever beam

	Ref.
- Uniformly distributed load	200
- Uniform load partially distributed at fixed end	201
- Uniform load partially distributed at free end	202
- Uniform load partially distributed	203
- Load increasing uniformly to free end	204
- Load increasing uniformly to fixed end	205
- Cosinusoidal distributed load	206
- Concentrated load P at free end	207
- Concentrated load P at any point	208
- Couple moment Mo at free end	209
- Couple moment Mo at any point	210

Fixed-fixed beam

	Ref.
- Uniformly distributed load	300
- Uniform load partially distributed at left end (I)	301
- Uniform load partially distributed at left end (II)	302
- Uniform load partially distributed	303
- Concentrated load at center	304
- Concentrated load at any point	305
- Two equal concentrated loads symmetrically placed	306
- Couple moment Mo at center	307
- Couple moment Mo at any point	308

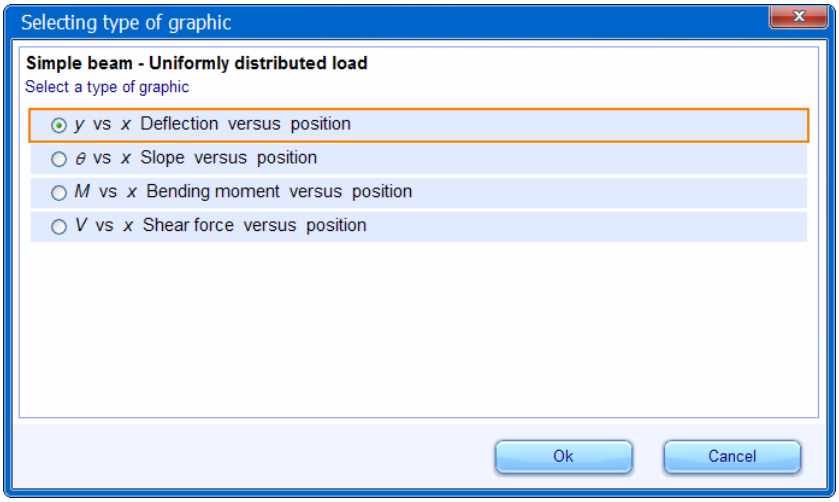
Fixed-pinned beam

	Ref.
- Uniformly distributed load	400
- Uniform load partially distributed at fixed end	401
- Uniform load partially distributed at supported end	402
- Uniform load partially distributed	403
- Concentrated load at center	404
- Concentrated load at any point	405
- Two equal concentrated loads symmetrically placed	406
- Couple moment Mo at any point	407
- Couple moment Mo at supported end	408

Overhanging beam

	Ref.
- Uniformly distributed load	500
- Uniformly distributed load on overhang	501
- Concentrated load at end of overhang	502
- Concentrated load at any point between supports	503

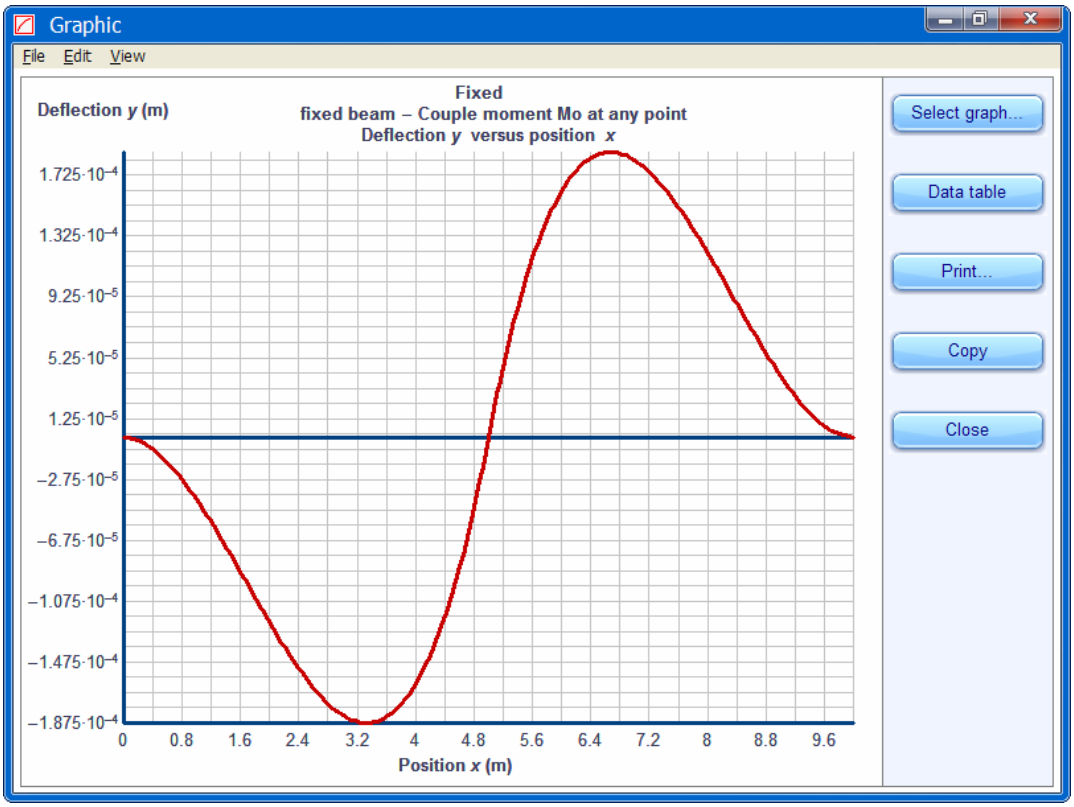
Selecting type of graphic window



Selecting type of graphic window

This window allows us to select the type of graphic to represent for the current beam and its load.

Graphic window



Graphic window

The *graphic* window shows the selected graph for the current type of beam and its load.

This window has the following menus and buttons:

File menu

Select type of graphic...
Open the *Selecting type of graphic* window.

Save image as...
Save the graph as a Bitmap file.

Print...
Open the *Print* dialog window. In it we can select the printer destination and specify the number of copies.

Close
Close the window.

Edit menu

Copy
Copy the graph into the clipboard.

View menu

Data table
Open the *Data table* window.

Buttons:

Select graph... button
Open the *Selecting type of graphic* window.

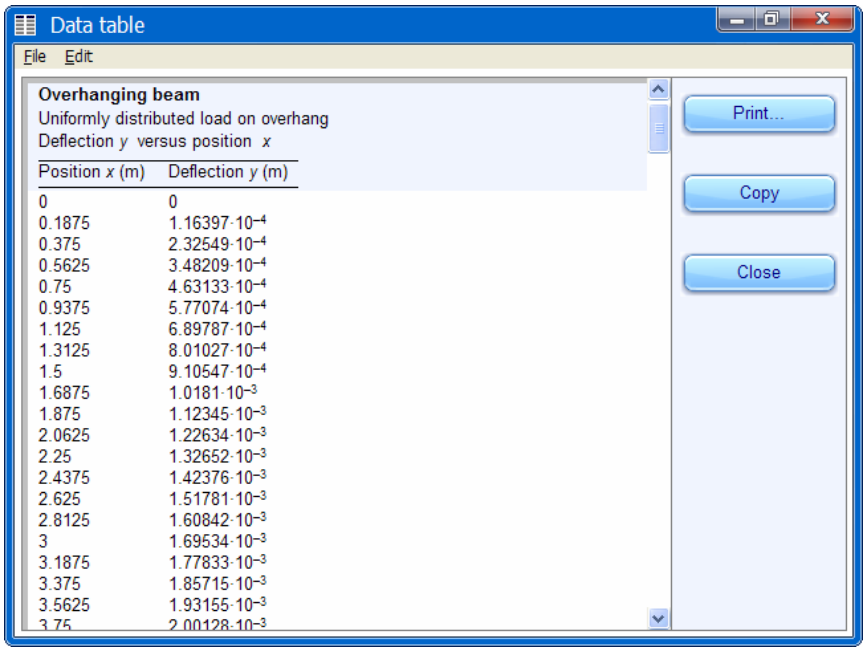
Data table button
Open the *Data table* window.

Print... button
Open the *Print* dialog window. In it we can select the printer destination and specify the number of copies.

Copy button
Copy the graph into the clipboard.

Close button
Close the window.

Data table window



Data table window

The *Data table* window displays the data table of the current graphic.

This window has the following menus and buttons:

File menu

Save data table as...
Save the data table as text file.

◆ **Note:**
Some formats might get lost.

Print...
Open the *Print* dialog window. In it we can select the printer destination and specify the number of copies.

Close
Close the window.

Edit menu

Copy
Copy the data table into the clipboard.

◆ **Note:**
Some formats might get lost.

Print..
Open the *Print* dialog window. In it we can select the printer destination and specify the number of copies.

Buttons:

Print... button
Open the *Print* dialog window. In it we can select the printer destination and specify the number of copies.

Copy button
Copy the data table into the clipboard.

◆ **Note:**
Some formats might get lost.

Close button
Close the window.

Example

For a simple beam with uniformly distributed load, at x = 4 m, calculate deflection, maximum deflection, slope, bending moment, maximum bending moment, and shear force. Use the following data table.

Data table:

Physical quantity	Symbol	Value	Unit
Flexural rigidity	$E{\cdot}I$	120E6	$N{\cdot}m^2$
Length of beam	L	10	m
Distributed load	w_0	5000	N/m
Position	x	4	m

In the *Type of beam* button click on **Simple beam.**
In the *Type of load* list select **Uniformly distributed load**.
Fill the input textboxes with the data table and press **Calculate** button.

Results (at x = 4 m):

Physical quantity	Symbol	Value	Unit
Deflection	y	-5.1667E-3	m
Maximum deflection	y_{MAX}	-5.4253E-3	m
Slope	θ	-5.1389E-4	
Bending moment	M	60000	N·m
Maximum bending moment	M_{MAX}	62500	N·m
Shear force	V	5000	N

◆ **Note:**
Press the ***View report*** button for more details.

Types of graphics table

y vs. x	Deflection versus position
θ vs. x	Slope versus position
M vs. x	Bending moment versus position
V vs. x	Shear force versus position

Shortcut keys

Main window

Ctrl + F4	Exit
Alt + F4	Exit
F1	Help: Show User's Manual (PDF document...)

Graphic window

Ctrl + E	Open the *Selecting type of graphic* window
Ctrl + S	Save graphic as Bitmap file
Ctrl + P	Print graphic
Ctrl + C	Copy graphic into clipboard
Ctrl + T	Open the *Data table* window
Ctrl + F4	Close window
Alt + F4	Close window

Data table window

Ctrl + S	Save data table as text file (*)
Ctrl + P	Print data table
Ctrl + C	Copy data table into clipboard as text (*)
Ctrl + F4	Close window
Alt + F4	Close window

(*) **Note:**
Some formats might get lost.

Specifications

Description	***BECA - Beam deflection calculator*** is a Windows application to calculate deflection, slope, bending moment, shear force and reactions of beams.
Precision	Output: between 4 and 12 significant digits.
Decimal separator for input values	Point or comma.
Decimal separator for output values	The same separator that used in the last value entered or the last one selected in the setup menu.
Types of graphics	**4 types** (view *Types of graphics* table)
Types of beams	**5 types of beams:** - Simple beam - Cantilever beam - Fixed-fixed beam -´Fixed-pinned beam - Overhanging beam
Types of loads for each beam:	**54 types of loads:** - Simple beam (21 types of loads) - Cantilever beam (11 types of loads) - Fixed-Fixed beam (9 types of loads) - Fixed-pinned beam (9 types of loads) - Overhanging beam (4 types of loads)

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