

# User's Manual

**BECA**  
Version 1.12.0

## Civil engineering software Beam deflection calculator for Windows

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



## INDEX

Introduction.....	3
Terms of use.....	3
Main window.....	4
Types of beams and loads table.....	8
Simple beam.....	8
Cantilever beam.....	8
Fixed-fixed beam.....	8
Fixed-pinned beam.....	9
Overhanging beam.....	9
Selecting type of graphic window.....	10
Graphic window.....	11
Data table window.....	13
Example.....	15
Types of graphics table.....	16
Shortcut keys.....	17
Specifications.....	18
Registered trademarks.....	19

## 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

VaxaSoftware - Beam deflection calculator for Windows

File Type of beam Setup Help

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

Simple beam - Uniformly distributed load

Uniformly distributed load

Uniform load partially distributed at left end (I)  
Uniform load partially distributed at left end (II)  
Uniform load partially distributed  
Uniform load partially distributed at each end

Flexural rigidity (N-m<sup>2</sup>) Length (m) Distributed load (N/m)  
E-I = 1.23457E7 L = 10 w<sub>0</sub> = 1234

Position (m)  
x = 4

Graph View report Calculate Clear

Deflection (m) Maximum deflection (m) Shear (N)  
y = -0.0123943 y<sub>MAX</sub> = -0.0130148 V = 1234

Moment (N-m) Maximum moment (N-m)  
M = 14808 M<sub>MAX</sub> = 15425

Slope Slope at A Slope at B  
θ = -1.23276E-3 θ<sub>A</sub> = -4.16474E-3 θ<sub>B</sub> = 4.16474E-3

Deflection  $y_{AB} = \frac{-w_0 x}{24 EI} (L^3 - 2Lx^2 + x^3)$

Slope  $\theta_{AB} = \frac{-w_0}{24 EI} (L^3 - 6Lx^2 + 4x^3)$   
 $\theta_A = -\theta_B = \frac{-w_0 L^3}{24 EI}$

Moment  $M_{AB} = \frac{w_0 x}{2} (L - x)$

Shear  $V_{AB} = \frac{w_0}{2} (L - 2x)$

$y_{MAX} = \frac{-5w_0 L^4}{384 EI}$   $M_{MAX} = \frac{w_0 L^2}{8}$  at  $x = \frac{L}{2}$

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 rigidity:

Physical quantity	Units
Length, distance, position	m, cm, mm, $\mu\text{m}$ , ft, in
Deflection, deformation	m, cm, mm, $\mu\text{m}$ , 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·m <sup>2</sup> , kN·m <sup>2</sup> , MN·m <sup>2</sup> , GN·m <sup>2</sup> , lbf·in <sup>2</sup> , ksi·in <sup>4</sup> , Pa·m <sup>4</sup> , kPa·m <sup>4</sup> , MPa·m <sup>4</sup> , GPa·m <sup>4</sup> , psi·in <sup>4</sup> , kp·m <sup>2</sup> (kgf·m <sup>2</sup> )

## 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.vaxasoft.com)...

Connect to VaxaSoftware home page.

An active Internet connection and a browser are required.

## Updates

### Check now...

The software connects to Internet to check for updates.

An active Internet connection is required.

### Update period...

Allows us to adjust the period between checks for updates.

The following settings are available:

- Once a day.
- Once a week.
- Once a month.

### 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  $2 \times 10^{-4} = 0.0002$ )

### ◆ 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:

$5.67 \times 10^{89}$  is entered as 5.67 E 89  
 $1.23 \times 10^{-34}$  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

	<b>Ref.</b>
- 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 $M_0$ at right end	113
- Couple moment $M_0$ at left end (I)	114
- Couple moment $M_0$ at left end (II)	115
- Couple moment $M_0$ at center	116
- Couple moment $M_0$ at any point	117
- Couple moments $M_1$ and $M_2$ at each end (I)	118
- Couple moments $M_1$ and $M_2$ at each end (II)	119
- Two equal couple moments $M_0$ at each end	120

### Cantilever beam

	<b>Ref.</b>
- 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 $M_0$ at free end	209
- Couple moment $M_0$ at any point	210

### Fixed-fixed beam

	<b>Ref.</b>
- 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 $M_0$ at center	307
- Couple moment $M_0$ at any point	308



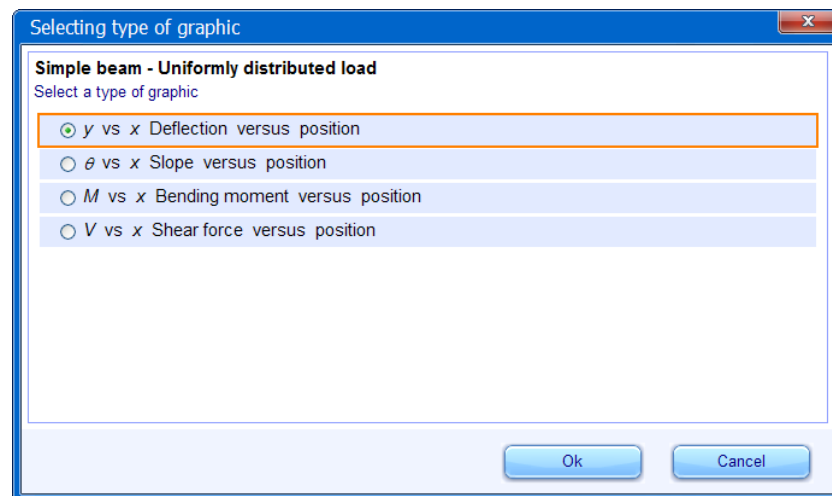
### **Fixed-pinned beam**

	<b>Ref.</b>
- 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 $M_0$ at any point	407
- Couple moment $M_0$ at supported end	408

### **Overhanging beam**

	<b>Ref.</b>
- 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

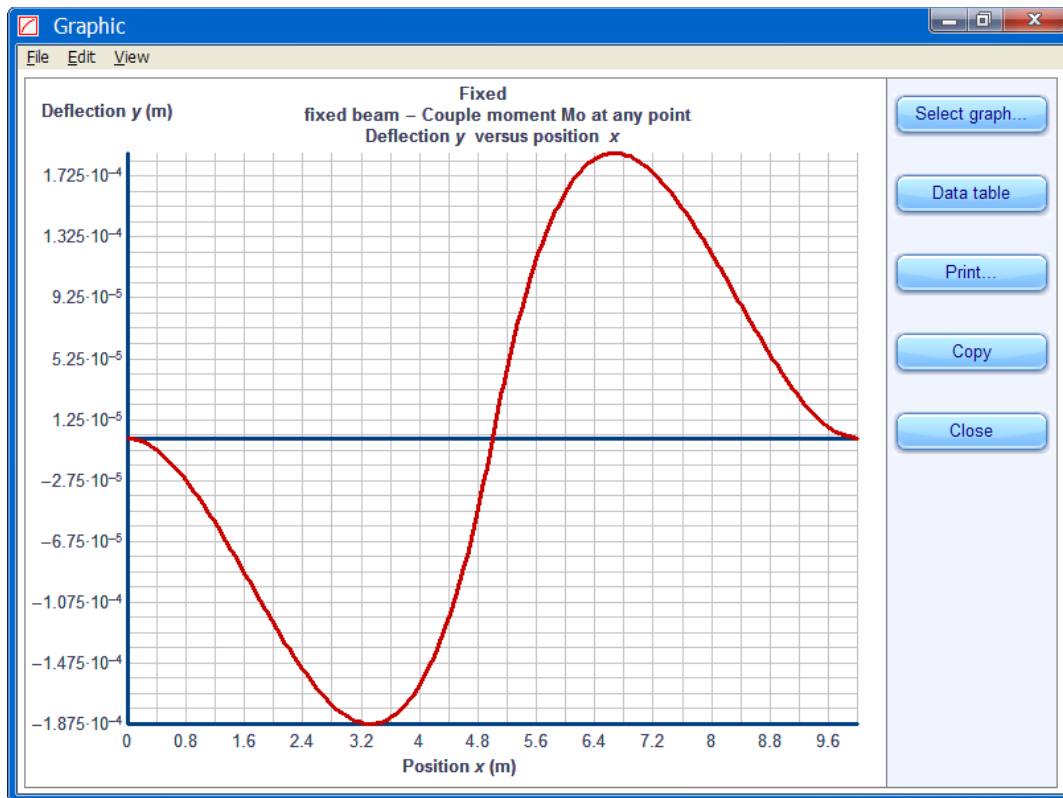
## Selecting type of graphic window



*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.

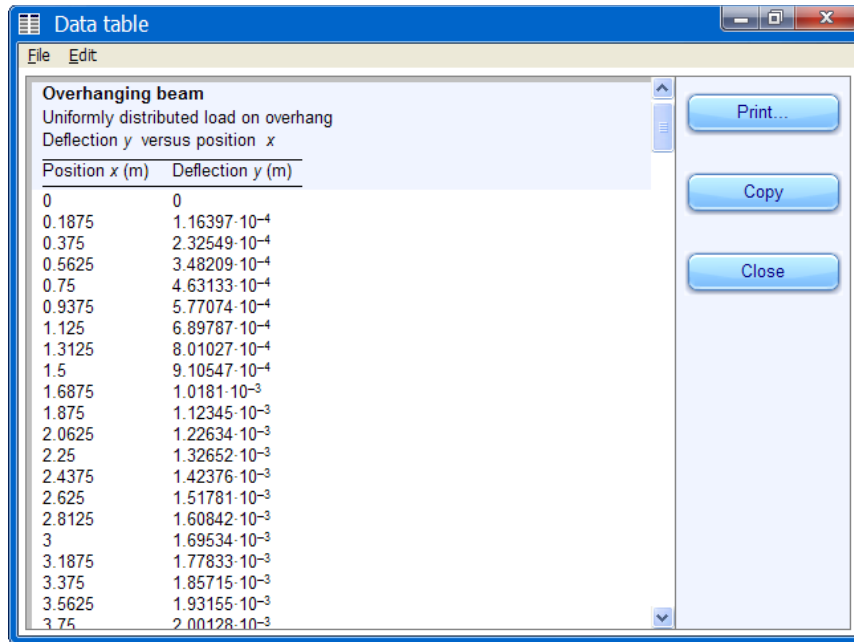
### **Copy** button

Copy the graph into the clipboard.

### **Close** button

Close the window.

## Data table window



The screenshot shows a window titled "Data table" with a menu bar containing "File" and "Edit". The main content area displays the following text and table:

**Overhanging beam**  
Uniformly distributed load on overhang  
Deflection  $y$  versus position  $x$

Position $x$ (m)	Deflection $y$ (m)
0	0
0.1875	$1.16397 \cdot 10^{-4}$
0.375	$2.32549 \cdot 10^{-4}$
0.5625	$3.48209 \cdot 10^{-4}$
0.75	$4.63133 \cdot 10^{-4}$
0.9375	$5.77074 \cdot 10^{-4}$
1.125	$6.89787 \cdot 10^{-4}$
1.3125	$8.01027 \cdot 10^{-4}$
1.5	$9.10547 \cdot 10^{-4}$
1.6875	$1.0181 \cdot 10^{-3}$
1.875	$1.12345 \cdot 10^{-3}$
2.0625	$1.22634 \cdot 10^{-3}$
2.25	$1.32652 \cdot 10^{-3}$
2.4375	$1.42376 \cdot 10^{-3}$
2.625	$1.51781 \cdot 10^{-3}$
2.8125	$1.60842 \cdot 10^{-3}$
3	$1.69534 \cdot 10^{-3}$
3.1875	$1.77833 \cdot 10^{-3}$
3.375	$1.85715 \cdot 10^{-3}$
3.5625	$1.93155 \cdot 10^{-3}$
3.75	$2.00128 \cdot 10^{-3}$

On the right side of the window, there are three buttons: "Print...", "Copy", and "Close".

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	$EI$	120E6	$\text{N}\cdot\text{m}^2$
Length of beam	$L$	10	m
Distributed load	$w_0$	5000	$\text{N}/\text{m}$
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	$y_{\text{MAX}}$	-5.4253E-3	m
Slope	$\theta$	-5.1389E-4	
Bending moment	$M$	60000	$\text{N}\cdot\text{m}$
Maximum bending moment	$M_{\text{MAX}}$	62500	$\text{N}\cdot\text{m}$
Shear force	$V$	5000	N

### ◆ Note

Press the **View report** button for more details.

## Types of graphics table

y vs. x	Deflection versus position
$\theta$ vs. x	Slope versus position
M vs. x	Bending moment versus position
V vs. x	Shear force versus position



## Shortcut keys

### **Main** window

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

### **Graphic** window

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

### **Data table** window

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

#### (\*) **Note**

Some formats might get lost.

## Specifications

<b>Description</b>	<b>BECA - Beam deflection calculator</b> is a Windows application to calculate deflection, slope, bending moment, shear force and reactions of beams.
<b>Precision</b>	Output: between 4 and 12 significant digits.
<b>Decimal separator for input values</b>	Point or comma.
<b>Decimal separator for output values</b>	The same separator that used in the last value entered or the last one selected in the setup menu.
<b>Types of graphics</b>	<b>4 types</b> (view <i>Types of graphics</i> table)
<b>Types of beams</b>	<b>5 types of beams:</b> <ul style="list-style-type: none"><li>- Simple beam</li><li>- Cantilever beam</li><li>- Fixed-fixed beam</li><li>- Fixed-pinned beam</li><li>- Overhanging beam</li></ul>
<b>Types of loads for each beam:</b>	<b>54 types of loads:</b> <ul style="list-style-type: none"><li>- Simple beam (21 types of loads)</li><li>- Cantilever beam (11 types of loads)</li><li>- Fixed-Fixed beam (9 types of loads)</li><li>- Fixed-pinned beam (9 types of loads)</li><li>- Overhanging beam (4 types of loads)</li></ul>

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