VIRUTAL INSTRUMENT FOR DETERMINING THE MAXIMUM DEFORMATION IN A SIMPLY SUPPORTED BEAM

BUȘEGA Vlad George[1] and Conf. dr. ing. SPÂNU Paulina [2]
1Faculty of Industrial Engineering and Robotics, Study field: Industrial Engineering, Year of study: I,
e-mail vlad_george.busega@stud.fiir.upb.ro
[2]Faculty of Industrial Engineering and Robotics, Manufacturing Engineering Department, University POLITEHNICA of Bucharest

ABSTRACT: This paper describes the results obtained by designing and creating a virtual instrument made in the LabVIEW graphical programming environment, with which material resistance calculations are performed. The virtual tool allows the calculation of the maximum deflection at a point located a distance X from the left support for a bar supported by a simple support and fixed at one end when subjected to a concentrated force at the middle.

KEY WORDS: LabVIEW, deflection, concentrated force, simple support

1. Introduction

Solving problems in the field of material resistance requires laborious and complex mathematical calculations. Sometimes, mistakes can be made in performing calculations that can lead to erroneous results. In addition, the time required for calculating the results and plotting the diagrams is quite high.

The virtual tool allows the quick and correct calculation of the reactions for a bar supported by a simple support on the right side and fixed on the left side, based on the formulas given in the specialized literature. The calculation formulas are based on the length of this bar, the distance from the left support to the point where we want to find the deformation and the concentrated force applied. Regardless of the values specified as input data, when the program is run, the loading pattern of the bar, its deformation and the maximum value of the deformation at the desired point will be plotted.

2. Current Stage

Bar fixed at one end and supported by a simple support at the other end subjected to a concentrated force and its deformation for which the virtual instrument is developed is represented in figure 1.

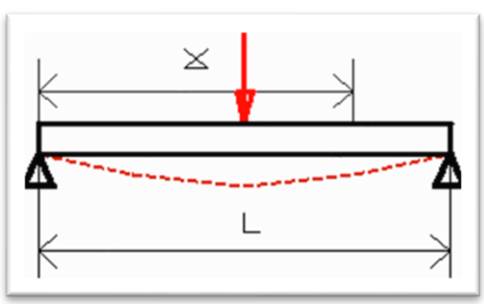

Fig. 1. Simply supported beam

The bar for which the length L = 70m is fixed at the left end and rests on a simple support at the right end. It is subjected to a concentrated force P = 55 N/mm2 in the middle.

Virtual instrument for simulating the deformation of a fixed bar at one end under the action of the forces

To calculate the maximum deformation M(x) at a point located at a distance of X = 30 m, formula 1 is used:

$$\boldsymbol{M(x) = \frac{P}{2}(L - X)} \tag{1}$$

where:
M(x) – Maximum deformation at point x;
L – Length of the bar;
P – The concentrated force;
X – The distance from the left support of the bar to the point where the maximum deflection is calculated.

3. Description of how does the virtual instrument work

On the front panel visible to the user, the following control elements are available through which the input data is specified:

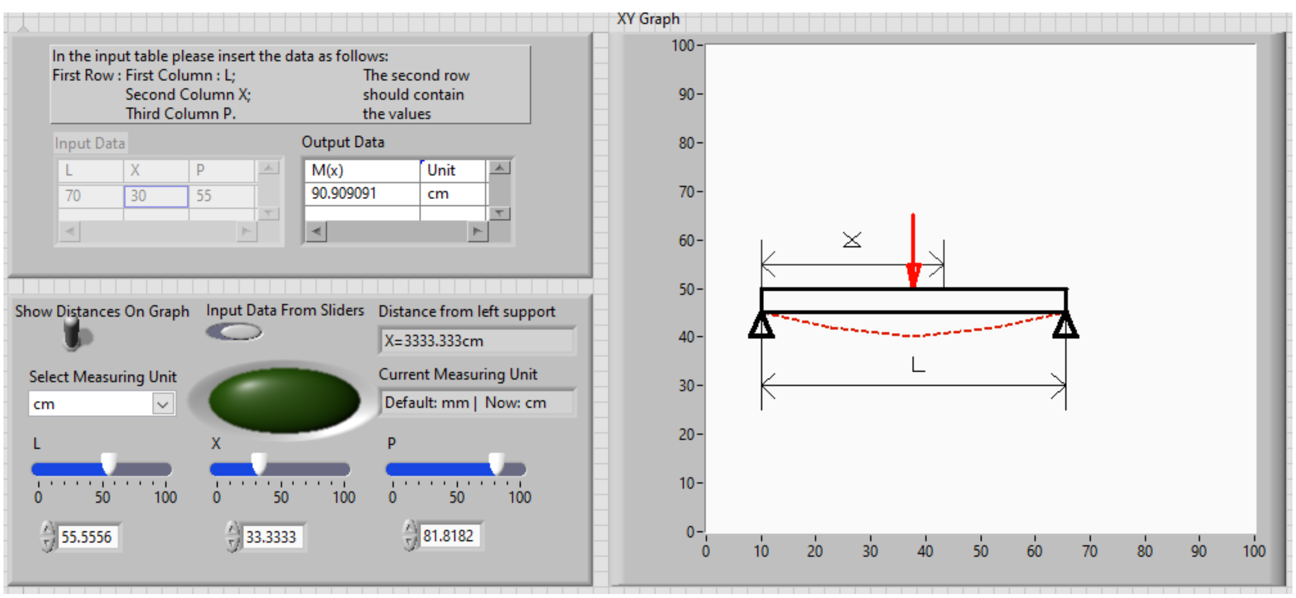

Fig. 2. User Interface

- A table for entering the length (L) of the bar, the distance from the left support to the point where the calculation of the maximum deformation (X) is desired and the concentrated force applied to the bar in the middle (P).
- A box with several options from which the user can choose the unit of measurement for length L and distance X.
- A switch to enable or disable the display of distances on the XY graph.
- A switch that allows the user to choose the way in which the data is entered: The standard way, by entering the data in the previously mentioned table or through the "Slide" type control elements to be able to follow in real time the changes made to the graphical representation of the bar chart.

When running the program, the virtual instrument will display the following in the indicator elements:

- A table showing the maximum deformation M(x) and the unit of measure used;
- The distance X entered;
- The unit of measure selected and used by the program for calculations;
- A led that indicates to the user if the distance X is greater than the length L of the bar;
- An XY Chart in which the bar chart is represented.

4. Description of the virtual instrument algorithm

In the virtual instrument diagram, the "Formula Node" structure was used to calculate the results of the problem. Formula 1 was introduced in the "Formula Node" structure, respecting the order of operations in arithmetic. The expression was terminated with a semicolon. Fig. 3.

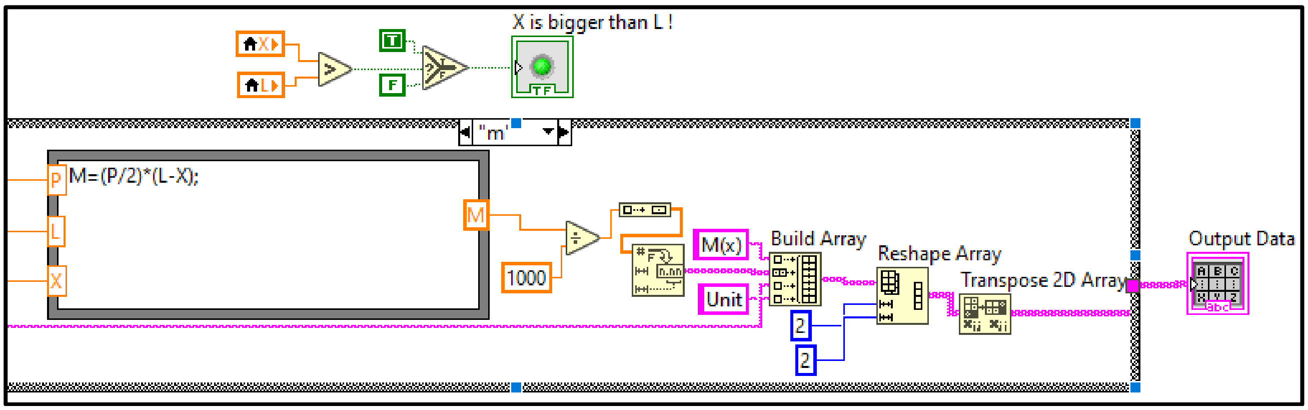

Fig. 3. Formula node in Case structure

The value calculated using the "Formula Node" structure is then divided by the corresponding value to be displayed in the unit of measurement selected by the user. Then, with the obtained value, a matrix is formed through the "Build Array" structure to which text is added using another "Build Array" structure, the matrix is then resized and transposed so that it can finally be inserted into the "Output Data" table so that the user can see the final result. Fig. 3.

To display the drawing, I used three sub-vi's joined by a "Build Array" structure to get the final graph represented by the "XY Graph" structure, which consists of three parts.

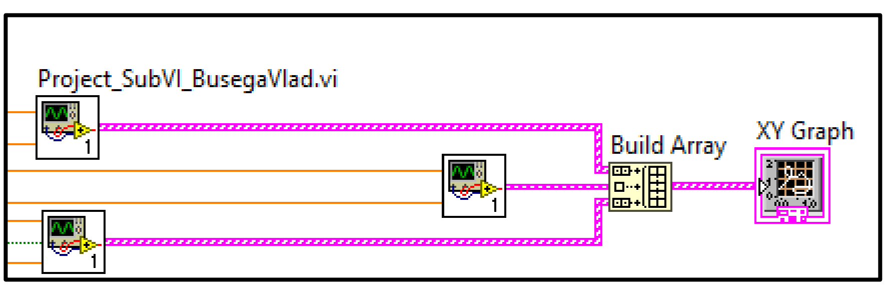

Fig. 4. The three sub-vi's

The main schema is represented by a cluster built using the "Bundle" structure. Each cluster contains the string of values of the numerical coordinates X and the string of values for Y.

Each string was built in turn using a "Build Array" structure.

The values for X and Y were obtained by processing the input data L and X entered by the user.

In Fig. 5. You can see the algorithm used for the graphic representation of the exercise.

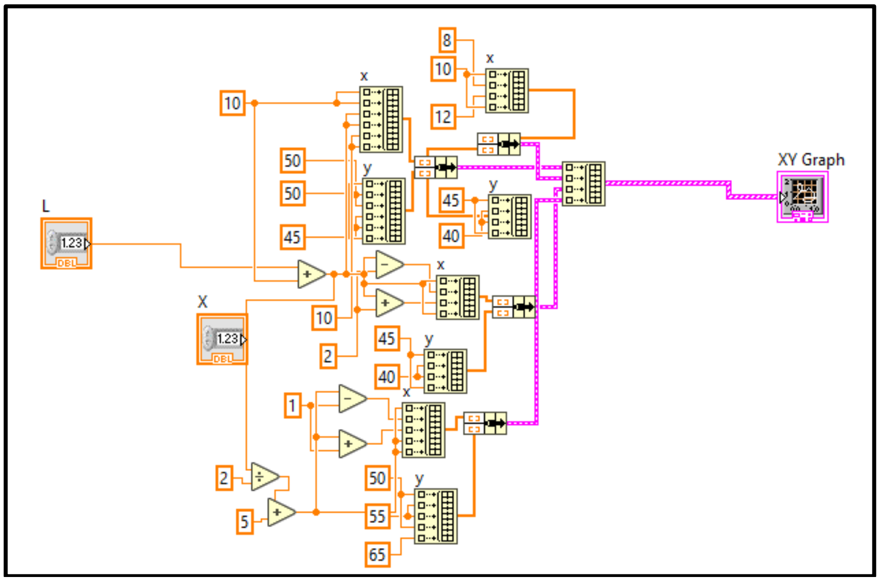

Fig. 5. Algorithm for graphical representation of the exercise

5. Conclusions

The created virtual tool correctly and efficiently solves a problem of the strength of concrete materials, based on formulas from the specialized literature. It has a simple, intuitive and easy-to-use interface for users with no programming experience.

As future research directions, it is recommended to improve the programmer interface by obtaining drawings using "Pictures" type functions.

Also, the writing of calculated results and drawings in a report or files is considered because they are accessible to any user, without the need for "LabVIEW" software.

6. References

[1]. Jiga, G., (2014) Strength of Materials,Volume 1, Ed. PRINTECH, Bucureşti, ISBN 978-606-23-0168-2.

[2]. Savu T., Spânu P., Abaza B., (2014), Reprezentări grafice – îndrumar de laborator, Ed. PRINTECH, Bucureşti, ISBN 978-606-23-0230-6.

[3]. Spânu P, Savu T., Abaza B., (2018) Bilingual Laboratory Guide (Romanian -English) Computer Programming, Ed. Printech Bucuresti , ISBN 978-606-23-0819-3.