VIRTUAL TOOL FOR DETERMINING REACTIONS AND DRAWING EFFORT DIAGRAMS

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ABSTRACT: This paper describes a virtual instrument that allows checking a fixed structural system consisting of two sections with different diameters, required under the action of a force applied at a point for which the position can be varied. The stress state resulting from the loads is determined based on the static balance equations recommended by the specialized literature. To perform the calculations and draw the diagram, the static balance equation was used, respectively a displacement compatibility equation.

KEYWORDS: virtual tool, axial stress, diagram, LabVIEW.

1. Introduction

Solving the problem strength of the material is a frequently imposed requirement in industrial applications. The variety of problems and the time required to solve them require finding solutions that meet the needs of engineers and students to optimize time and the results obtained. In this context, a virtual instrument was developed in the LabVIEW graphic programming environment, which allows for determining the reactions, drawing the axial stress diagram, and checking the bar for a force applied to the section of bars made of the same material.

2. Current status

The study was carried out for the structure of steel bars, requested at point C by the force P according to figure 1.

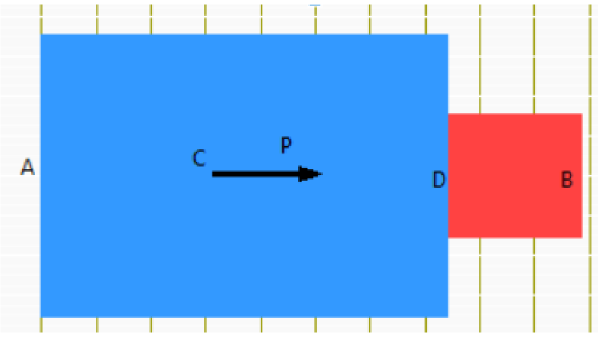

Fig. 1. Load diagram of the bar section

The bars being made of steel, the value of the admissible resistance R = 235 N/mm^2 and the modulus of elasticity E = 210, N/mm^2 were considered.

The areas of the two sections were pointed with A1 and A2, respectively, and were expressed in mm.

The state of stress is influenced by the ratio of stiffnesses to axial stress because the cross-sectional area of the bar is not constant.

Relations used in the calculations were obtained based on the static equilibrium equation and the displacement compatibility equation [1].

$$H_A + H_B = P \tag{1}$$

$$\frac{H_A * L_1}{E * A_1} = \frac{H_B * L_2}{E * A_1} + \frac{H_B * L_3}{E * A_2} \tag{2}$$

Following the solution of the system formed by the static balance equation and the compatibility equation, the HA and HB reactions resulted. Based on the determined reactions, the axial stress diagram was drawn.

Description of running the virtual instrument

The front panel of the virtual instrument is the user interface. It must be intuitive and as easy to use as possible. As a result of these features, the front panel of the application was designed.

The input data in the program are the force P, the areas of the two sections A1 and A2, the lengths of the sections L1, L2, and L3, and the admissible resistance R. To specify the values of the input data, the user has at his disposal numerical control elements.

To display numerical results, Metter indicator elements for HA and HB reactions and two Tank indicator elements for SAD and SAB stress were added to the front panel. If their values are lower than the admissible limit, the program will display a message through the LED indicator element.

Figure 2 shows the panel of the virtual instrument.

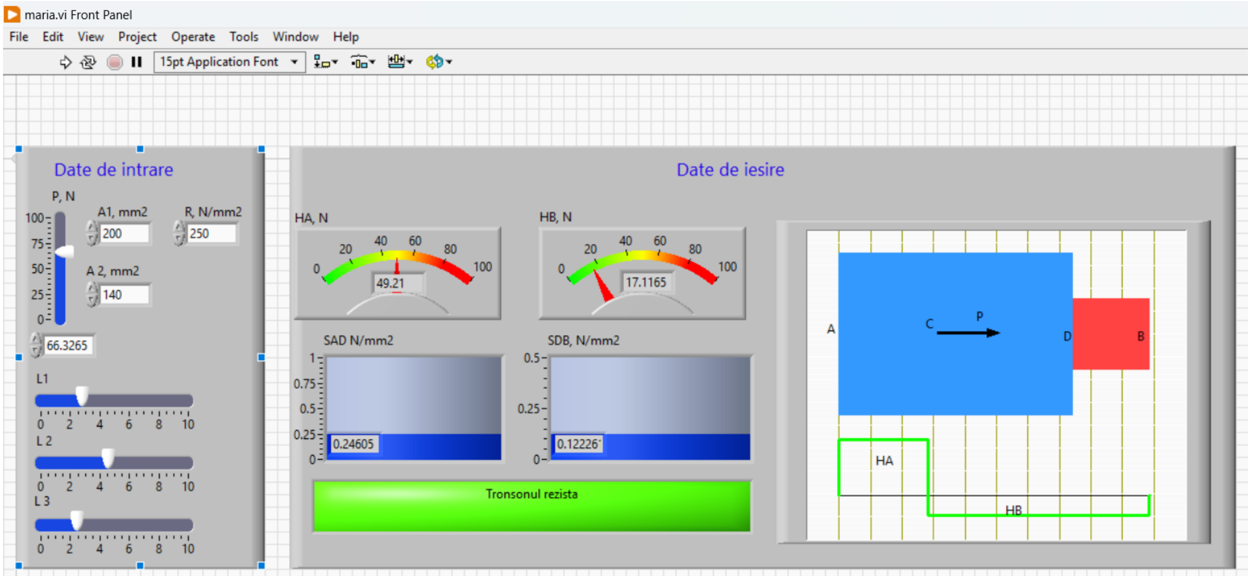

Fig. 2. Front panel

An XY Graph indicator element is also available on the virtual instrument panel where the program will show you the drawing of the bar section and the axial stress diagram.

The program allows the calculation of the results and the representation of the loading scheme, depending on the numerical values entered by the user through the control elements.

Description of the programming algorithm

The virtual instrument diagram represents the interface to the programmer. The programming algorithm was realized in the virtual instrument diagram. This was developed in two parts. In the first part, the program for calculating the results was created using the Formula Node.

In the Formula Node structure, formulas 1 and 2 were introduced, respecting the order of operations in arithmetic.

Figure 3 shows the diagram of the virtual tool for calculating the results.

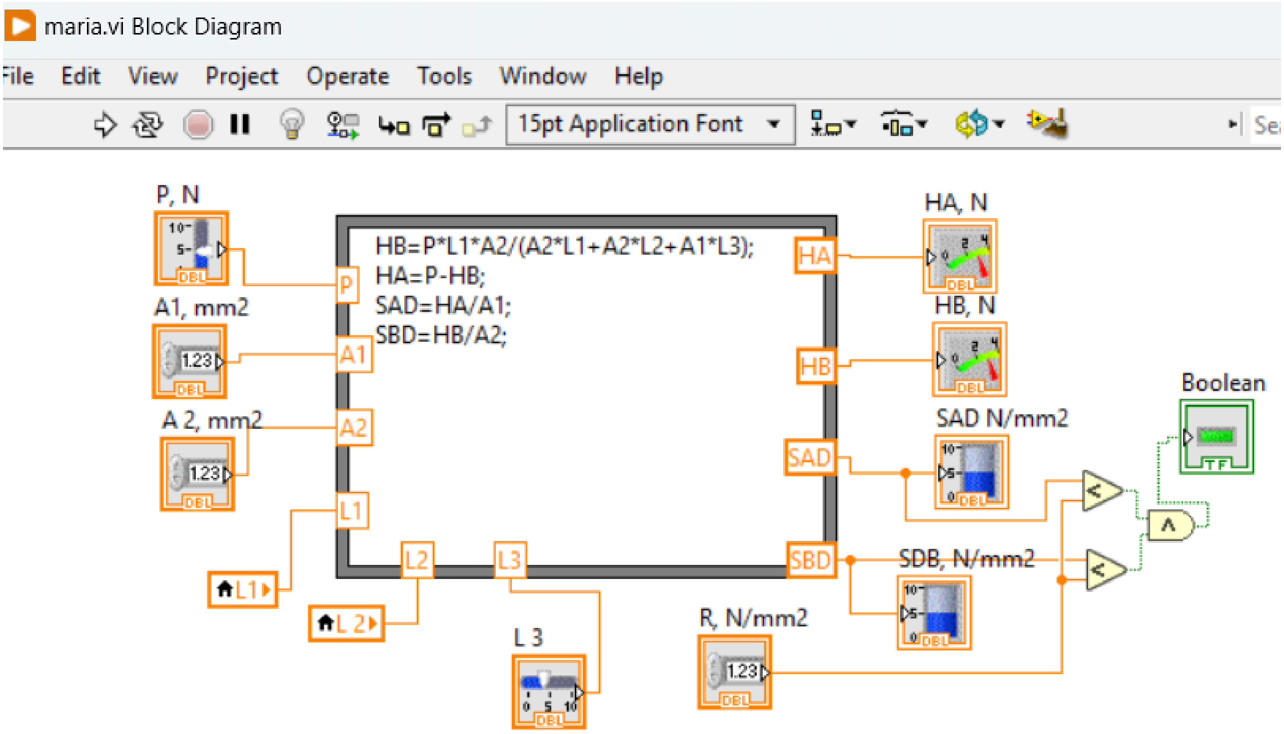

Fig. 3. Diagram of the virtual instrument for calculating the results

In the second part of the diagram, the programming algorithm was created for the representation of the bar section and the axial stress diagrams. The representation of the images was done by building several graphics that were represented simultaneously using the Build Array function.

Each graph was obtained with the Bundle function. To obtain a graph, the Build Array function was used, thus building the string of numerical values of the coordinates of the points on the graph.

Local variables for control elements and indicators have been used to simplify the diagram.

Figure 4 shows the second part of the virtual instrument.

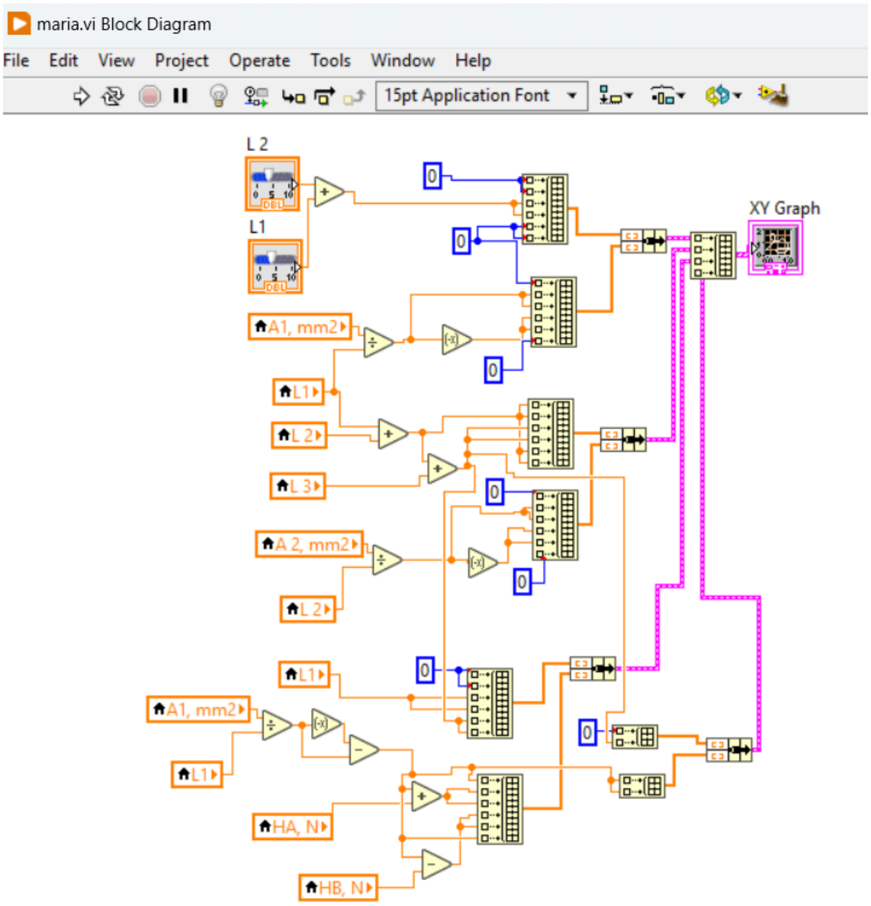

Fig. 4. Virtual instrument diagram for displaying the axial stress diagram

3. Conclusion

The current virtual instrument is recommended to solve a specific problem of stress material using the formulas from the specialized literature. It allows the calculation of reactions, allowable stresses while the user enters various input data.

As future research directions, the programmer interface will be improved using Pictures and property nodes.

The virtual tool will be developed so that it allows saving in files accessible to any user.

4. Bibliography

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