LABVIEW APPLICATION FOR CALCULATING STRESS IN A STEEL BAR

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ABSTRACT: The designed LabView application calculates and displays the stress in a steel bar with two simple supports on each side, the bar itself having two different dimensions. Using 2 main equations for deformation and stress, the VI calculates how the bars will behave under temperature changes. The program uses a formula node to do most of the exercise, then using string functions displays the resulting sigmas (stresses) in an easy-to-read format on the front panel. The program also has a slider to choose the unit of measurement between Pa and MPa, using case functions to change between them.

1. Introduction

Upon temperature change, deformation starts to occur in most materials. For metals, such as steel, temperature differences can alter the material quite fast. This is an effect that happens in real cases with weather, so any engineer needs to be able to tell how materials behave in such conditions. Using a formula node, the program calculates sigma (stress) in the steel bars and all the elements needed until it reaches the stress formula. Then, using string functions and arrays, it displays the values obtained for each sigma, the unit of measurement and the names of the variables. The program also has a slider to choose which unit to show the results in (Pa or MPa), using a case function to either multiply or divide the value obtained to have it in the right unit.

2. Translating the exercise into basic computations in a VI

Laboratory 1 – Elementary functions for numeric values; Understanding the problem and doing basic calculations using numeric functions. We use the equations to calculate stress, but we do it in a simple drag-drop-link manner. Very rudimentary start.

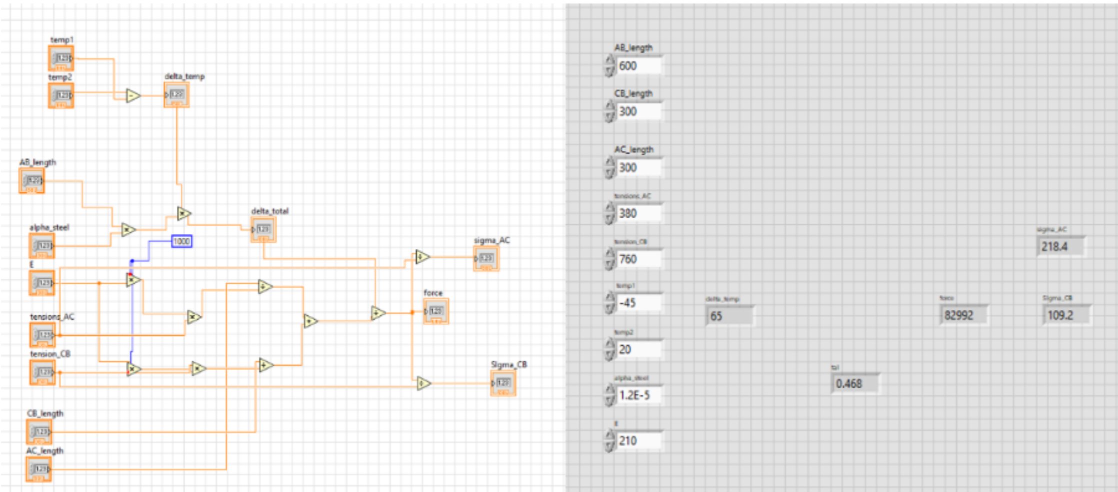

Fig. 1. First VI with simple computations

3. Organizing the VI with Formula Nodes

Laboratory 2 – Generating random numeric values; Using formula nodes to clean up the block diagram. Linking all the variables to the formula node and using the equations to calculate everything. The front panel stays the same as before.

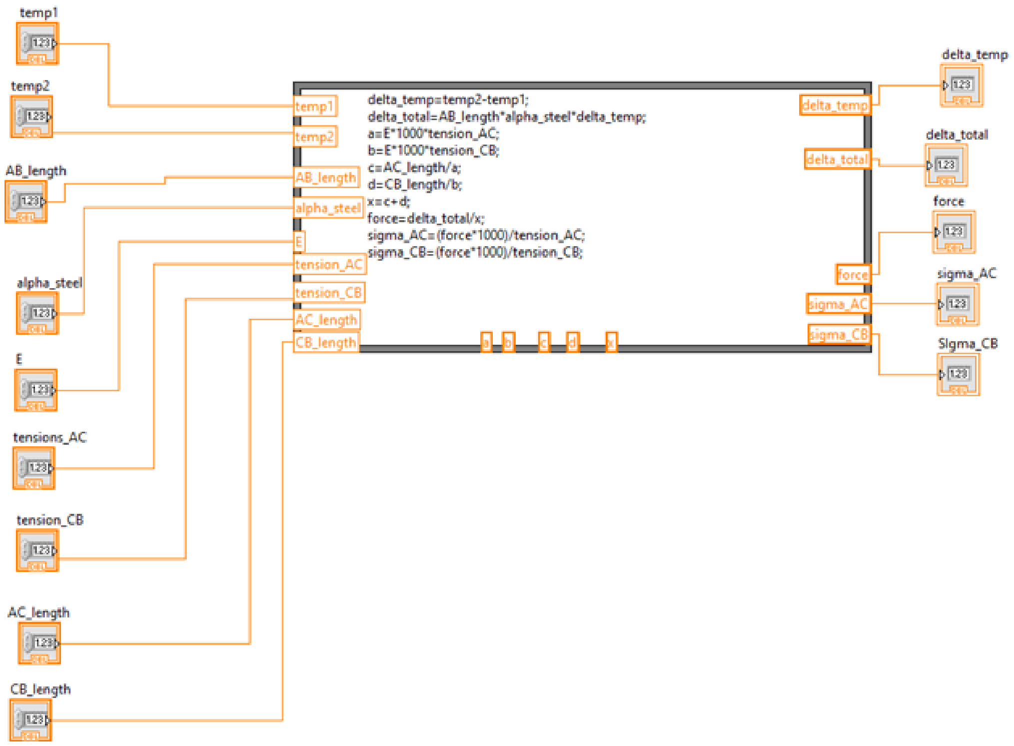

Fig. 2. Formula node containing all equations

4. Adding string elements to display the results

Laboratory 3 – Using the functions for the string data; Using string functions to display the results in a simple-to-read manner, adding a slider to choose between Pa and MPa. We achieve this by using a case function to multiply or divide by 100 for each unit of measure. The program changes the result as the user selects.

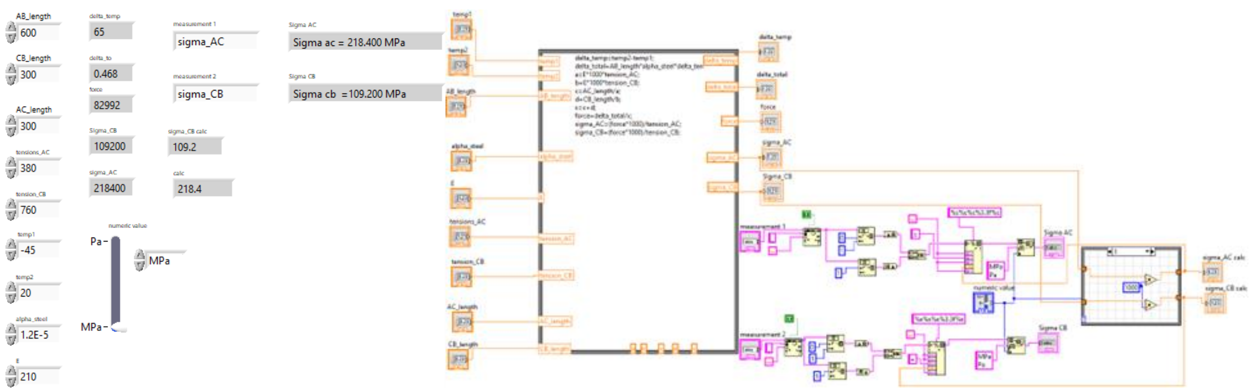

Fig. 3. Organized VI with string type results and case function

5. Using arrays to display the results in a table

Laboratory 4 – Array functions; Using arrays to arrange the values and their names in a simple table. With only two, the table for my problem is small, but the concept is very important for larger scale projects.

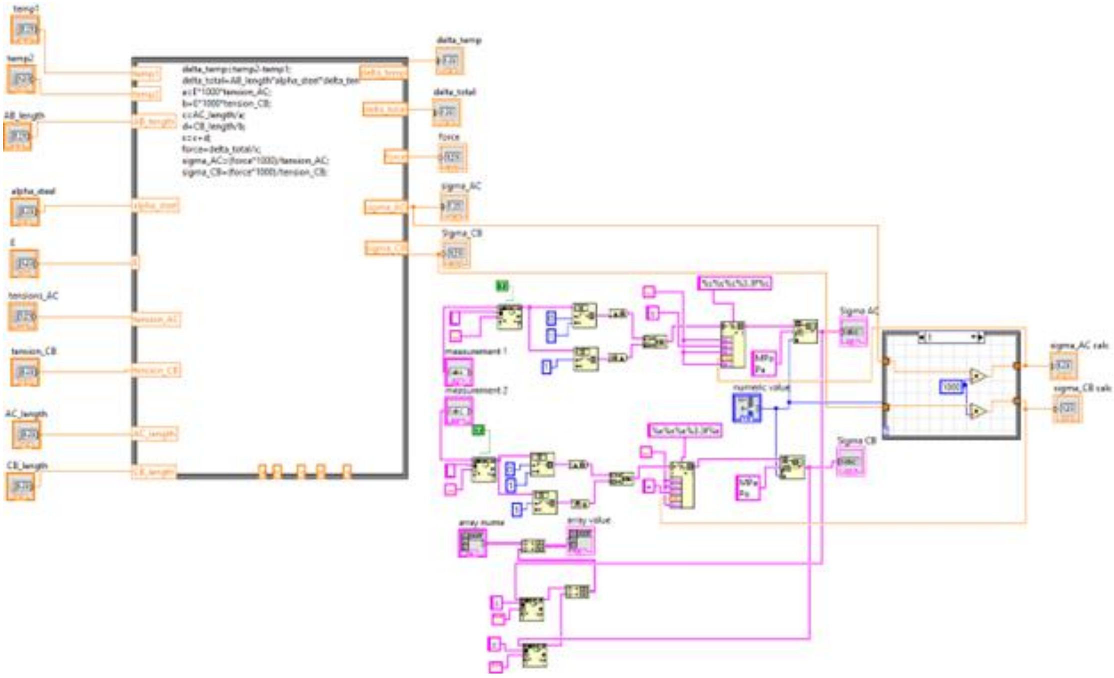

Fig. 4. Current VI with arrays

6. Current state

Finally, we achieve a program able to help us calculate the stresses in steel bars, and display all the results in a neat and clean manner. As for future updates, I plan to add a graph and pictogram of the scheme for the exercise. The graph will be able to plot the drawing using subVIs.

7. Equations

$$\Delta t = T_2 - T_1 \tag{1}$$

$$\delta_T = \sum L_i \alpha_i \Delta t \tag{2}$$

$$-\frac{F\times300}{210\times1000\times380}-\frac{F\times300}{210\times1000\times760}+0{,}468=0 \tag{3}$$

$$\sigma_{AC} = \frac{F}{T_{AC}};\ \sigma_{CB} = \frac{F}{T_{CB}} \tag{4}$$

Where: (1) Δt is the difference in temperature between T_1 and T_2;

(2) δ_T is the total deformation, which is calculated with the sum of lengths, α of steel and Δt;

(3) F is a sum of forces F_A and F_B, applied at their respective supports;

(4) σ_{AC} is the stress on portion AC, while σ_{CB} is on portion CB; T is the tension on each section;

8. Figures

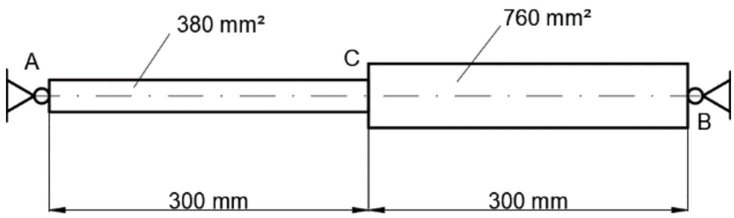

Fig. 5. Steel bar

9. Conclusion

The program aids with calculations of a steel bar similar to the one in the figure, only requiring input of a few values. Such programs can help engineers check buildings for issues.

My program uses formula nodes, string and array functions and a case function to complete a physics exercise in which we have to calculate stresses in two conjoined steel bars, affixed at each end with a simple support.

10. Bibliography

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