AC 2008-2057: STUDENT ACADEMIC DEVELOPMENT THROUGH PRESCRIBED UNDERGRADUATE PROJECTS

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Student Academic Development through Prescribed Undergraduate Projects

Abstract

In this paper a methodology for enhancing the academic development of sophomore-level engineering and engineering technology students using undergraduate projects is outlined and discussed. The specific sample project presented in the paper involves the development of MATLAB script files and LabVIEW Virtual Instruments (VIs) for solving several Engineering Mechanics problems. The development of the solution for these problems involves the utilization of a number of valuable programming tools and powerful techniques. The selected students will be guided to write a proposal to seek funding for the project through the *College Office of Undergraduate Research (COUR)* at the author's institution. The requested funds will be used to financially support the students during the summer. At the conclusion of the project the students are required to document their work in a concise and well written report in a publishable format. The students are also expected to present their project orally in an annual *COUR* Symposium held on campus, as well as in other off-campus venues. The selected project benefits each involved student in a variety of ways. A discussion will be incorporated in the paper to clearly establish the contribution of each component of the project in terms of the academic development of students and the overall value of the project. Included in the paper will also be examples of MATLAB script files and LabVIEW Virtual Instruments the students have to develop in this project. These examples clearly establish the utility and purpose of the proposed activity.

I. Introduction

This paper outlines a procedure which utilizes MATLAB and LabVIEW to contribute to the academic development of sophomore-level engineering and engineering technology students. The specific sample project included in this paper is mainly geared for students who are interested in pursuing a degree in civil, mechanical, or aerospace engineering. Similar projects can easily be designed for students pursuing other engineering fields.

To start this pilot project, a sophomore Mechanical Engineering Technology student was selected in the spring of 2008 to develop programs for analyzing beams. With the help from the author of the paper, the student has written and submitted a proposal to the *College Office of Undergraduate Research (COUR)* to secure the funding needed to undertake this project. The *COUR* office is housed in the College of Science and Technology at the author's institution. The requested funding is for supporting the student during two months (9 weeks) in the summer of 2008, while he works on developing the programs needed for the project. The selected student has already taken Statics and a programming course in MATLAB, and is currently enrolled in Strength of Materials. The guidance and support material for LabVIEW utilization will be provided by the author, since the student does not have a knowledge of this software tool.
The proposed project involves the development of programs for problems similar to ones included in this paper. The sample programs included in the paper illustrate how various powerful computing tools and programming features of MATLAB and LabVIEW can be

employed to develop the solutions for classic Mechanics of Materials problems. The utilization and advantages of these two powerful programming tools were discussed in earlier publications of the author[1-3]. Since MATLAB is widely used and well-known, the advantages of this software are not provided in the paper. The next few paragraphs provide more information related to the utility of LabVIEW.

Even though LabVIEW is mainly used for controlling laboratory instrumentations and acquiring experimental data, this tool can also effectively be utilized to develop the theoretical solution for engineering problems. In an earlier publication of the author some of the more important advantages of LabVIEW were outlined and discussed[3]. A brief summary of these advantages are provided below:

- LabVIEW has an attractive, convenient, and easy-to-use user interface. Using this interface (LabVIEW's front panel) problem input can be issued in variety of ways to display the output in any desired format.

- Ease with which MATLAB script files can be imported and used in LabVIEW. This is a very attractive feature of LabVIEW, since the programs already developed using MATLAB do not have to be rewritten to be utilized.

- Ease with which data from other files such as spreadsheets can be imported and used in the LabVIEW environment.

- Ease with which data can be exported into other file formats to be used with other applications.

- LabVIEW provides great interactive help and documentations for users to enable them to easily locate and fix their syntax errors.

- LabVIEW has great debugging tools.

- Flexibility of LabVIEW to handle text-based programming instructions. Using LabVIEW's "formula node" function, the users also have the option of using the text-based programming instructions in their programs when convenient.

- An existing extensive library of virtual instruments in LabVIEW further enhances the functionality of this software tool for solving engineering problems.

LabVIEW programs, also referred to as LabVIEW Virtual Instruments (VIs), have two main components; front panel and block diagram. The front panel is the interface between the user and the VI. Through the VI's front panel, the input and output to the VI can be controlled and displayed in any preferred format utilizing various electronic LabVIEW controls and indicators[4]. This convenient and user friendly interface is one of the most attractive features of labVIEW. The computations within the VI are performed via the programming instructions placed in the block diagram.

The seven important phases of the project, along with the benefits they offer, are outlined below to establish the significance and value of the proposed project.

1. Studying the fundamentals and gaining the background knowledge - In this phase of the project the student will be guided to carefully study the problem and fully comprehend all essential theoretical principles needed. During this phase, the faculty mentor will meet regularly with the student to provide the needed instructions and guidance.

   Benefit:
   The student will gain a firm understanding of the fundamental principles and establish a solid foundation for starting the project.

2. Developing the theoretical formulation for the project - Once the student has mastered the basic principles, he can proceed to develop the formulas needed for the specific problem assigned to him.

   Benefit:
   The student will learn how to apply his acquired knowledge to solve an engineering problem. This activity further enhances the student's knowledge of the subject and problem solving skills.

3. Developing programming skills in MATLAB and LabVIEW- In this important phase of the project, the student with the help from his faculty mentor will learn how to utilize various programming tools and powerful features of these two premiere engineering programming languages.

   Benefit:
   The skills learned in this phase of the project tremendously contribute to the future success of the student in other academic courses and beyond.

4. Developing the MATLAB script files and LabVIEW Virtual Instruments - Using the knowledge and skills learned in the previous phase, the student proceeds to create the special programs needed for his assigned project.

   Benefit:
   The student will have an opportunity to apply his gained programming knowledge to further sharpen his programming skills. It is during this phase that the student will learn more about his shortcomings and lack of understanding of concepts. This encourages the student to further study these concepts and master them. This phase is considered an important part of the project mainly since it provides a valuable experience for the student.

5. Evaluation of Programs Results - Using the programs developed in the previous phase, the student can conveniently modify the problem input and determine the solution of variety of problems instantaneously.

Benefit:
It is perhaps during this phase that the student can really attain a better understanding of the problem by analyzing, synthesizing, and evaluating the computed results.

6. Preparing a written report - At the conclusion of the project, the student is asked to document all of his work related to the project in a detailed fashion in a comprehensive report.

   Benefit:
   With the help from his faculty mentor, the student will learn how to present his findings in an organized and structured fashion worthy of a publication. This experience will be a valuable contributor to the student's future academic success.

7. Preparing an oral presentation - At the conclusion of the project, the student is also required to make oral presentations describing his work at an Undergraduate Research Symposium on campus, as well as in other professional meetings/conferences off-campus.

   Benefit:
   With the help from his faculty mentor, the student will learn how to effectively prepare an oral presentation for conveying technical information to a group of peers. This valuable skill will serve the student well in his future studies and professional career.

Examining the phases of the project listed above, it can be seen that the six levels of the cognitive domain as described in Bloom's taxonomy are considered in the various phases of project listed above; "Knowledge" and "Comprehension" through phases 1 and 3; "Application" through phases 2 and 4; "Analysis", "Synthesis", and "Evaluation" through phases 2 and 5.

The first three phases of the project related to acquiring the background knowledge, developing the theoretical formulation, and developing the programming skills in MATLAB & LabVIEW are to be completed during the spring semester of 2008. Phase four of the project involving the development of MATLAB script files and LabVIEW Virtual Instruments will be accomplished during two months of summer (9 weeks). The student will continue to complete his programs, evaluate the obtained results, document his work in a written report, and develop material for his oral presentation during the fall semester (phases five through seven).

The description of a sample project for analyzing a beam subject to a combined load is provided in the next section of the paper. Included in the paper are also the needed theoretical formulation for each part of the project and the corresponding developed Virtual Instruments. The presented components of the project more clearly establish the power and utility of MATLAB and LabVIEW, and illustrate how the designed project can contribute to the academic development of students.

In the proposed pilot project the student will be instructed to develop a powerful and flexible program in a form capable of analyzing a series of beam and loading conditions. Utilizing these programs, the user should be able to conveniently indicate the type of loading, and prescribe the beam and loading parameters to generate the results. These programs can further be used to create a variety of "what if" scenarios for consideration and discussion. Studying the solution for these cases, the student can attain a better understanding of the behavior of beams subjected to loads.

The experimental verification of the theoretical results using LabVIEW is not included in this project at this time considering the project time constraints, and knowing that this is a project designed for a sophomore-level student. Depending on the progress and success of the student, the experimental component can also be added. This addition nicely complements the project and provides another valuable educational experience for the student.

II. Sample Problem Description

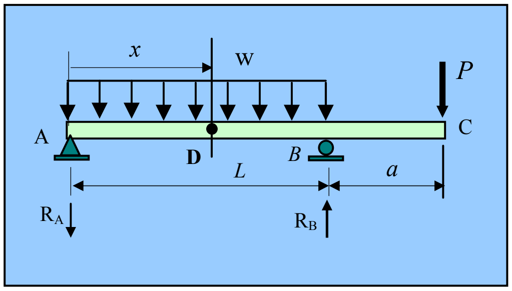
The description of a sample problem similar to the one included in the project is presented below to further illustrate the scope of this project.

An overhanging beam is subjected to a distributed load and a concentrated force as shown in Figure 1 (a) Develop a program to do the following:

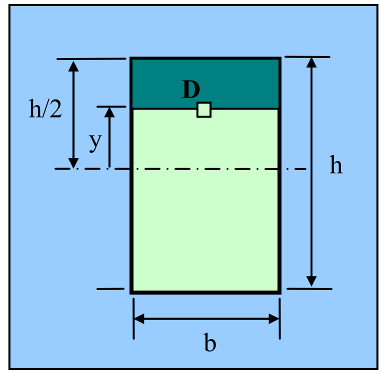
Part 1: Plot the distribution of shear, moment, slope, and deflection along the length of the beam for the following values of beam and loading parameters:
w = 2 kip/ft, P = 8 kip, L = 20 ft, a = 7 ft, E = 29000 ksi.

Part 2: Determine the principal normal and shearing stresses at point D (shown in Figure 1) located at the distance of x = 8 ft away from the left support and at the distance of y = 2 in. above the beam's neutral axis. Solve this problem for the beam and loading parameter shown in part 1 and for the following beam cross-sectional dimensions: b = 5 in, h = 8 in. Also, assuming that the allowable normal and shearing stress in the beam are respectively σ_{all} = 25 ksi, and τ_{all} = 15 ksi; determine if the beam is safe under the applied loads.

To solve this problem, the expression for shear, moment, slope, and deflection of the beam, as well as the equations for the principal stresses acting on a differential element of the beam should be obtained. The methodology for determination of this type of expressions is discussed in any basic Mechanics of Materials text[5] and is included in the next section of the paper. These expressions are utilized in the development of the LabVIEW Virtual Instruments presented in the paper.



(a)



(b)

Figure 1. (a) An overhanging Beam Subject to a Combined Distributed and Concentrated Load, (b) Rectangular Cross Section of the Beam Illustrating the Location of Point D

III. Theoretical Formulation

Determination of the Shear, Moment, Slope, and Deflection

To obtain the algebraic expression for shear, moment, slope, and deflection of the beam; each of the loads is applied separately and the expressions for each case is obtained and superimposed to yield the total values for the combined loading.

Applied Distributed Load Case:

To obtain the expressions for this case, the force and moment equilibrium equations for the two segments of the beam shown in Figures 2 (b) and 2 (c) can be written.

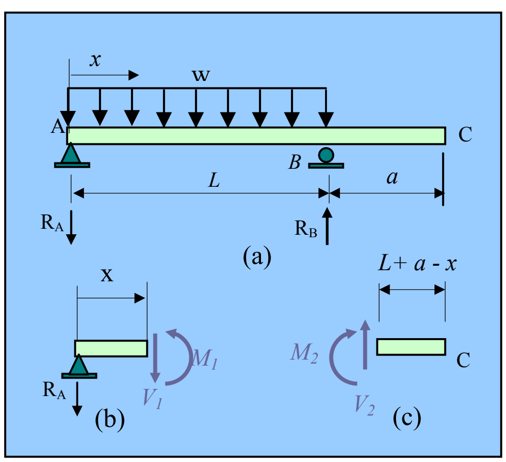


Figure 2. Free Body Diagram of the Beam Subject to the Distributed Load w

Application of these equations yields the following expressions for the two regions of the beam:

$0 \le x \le L$

$L \le x \le L + a$

$$V_1 = w(L/2 - x) \quad (1)$$

$$V_2 = 0 \quad (2)$$

$$M_1 = \frac{wx(L - x)}{2} \quad (3)$$

$$M_2 = 0 \quad (4)$$

Upon substituting for the moments M_1 and M_2 in the differential equation of the beam, the following equations are obtained for the beam under consideration:

$0 \le x \le L$

$L \le x \le L + a$

$$EIv_1'' = \frac{wx(L - x)}{2} \quad (5)$$

$$EIv_2'' = 0 \quad (6)$$

In these expressions; E, and I are respectively the modulus of elasticity and moment of inertia of the beam. All other parameters are as defined in Figure 2. Upon employing the method of successive integration and enforcing the beam's boundary conditions:

$$v_1(x = 0) = 0 \quad (7)$$

$$v_2(x = L) = 0 \quad (8)$$

and the continuity equations:

$$v_1(x = L) = v_2(x = L) \quad (9)$$

$$v_1'(x = L) = v_2'(x = L) \quad (10)$$

the following expressions for the slope and deflection are obtained for the two regions of the beam.

$$v_1' = \frac{w(6Lx^2 - 4x^3 - L^3)}{24EI} \quad (11)$$

$$v_2' = \frac{WL^3}{24EI} \quad (12)$$

$$v_1 = \frac{-wx(L^3 - 2Lx^2 + x^3)}{24EI} \qquad (13) \qquad\qquad v_2 = \frac{WL^3}{24EI}(X - L) \qquad (14)$$

Applied Concentrated Load Case:

Considering the equilibrium of the segments of the beam shown in Figures 3 (b) and 3(c), and following the same procedure outlined for the distributed load case, the following expressions for the shear, bending moment, slope, and deflection are obtained for the two regions of the beam.

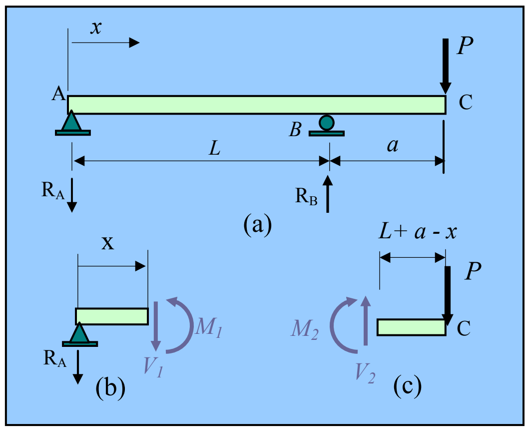


Figure 3. Free Body Diagram of the Beam Subject to the Concentrated Load P

$0 \le x \le L$ $\qquad\qquad$ $L \le x \le L + a$

$$V_1 = \frac{-Pa}{L} \qquad (15) \qquad\qquad V_2 = P \qquad (16)$$

$$M_1 = \frac{-Pax}{L} \qquad (17) \qquad\qquad M_2 = -P(L + a - x) \qquad (18)$$

$$v_1' = \frac{-P}{6EIL}(3ax^2 - aL^2) \qquad (19) \qquad\qquad v_2' = \frac{-P}{6EI}\left[-3(L + a - x)^2 + a(3a + 2L)\right] \qquad (20)$$

$$v_1 = \frac{-Pax}{6EIL}(x^2 - L^2) \qquad (21) \qquad\qquad v_2 = \frac{-P}{6EI}\left[(L + a - x)^3 + a(3a + 2L)x + a(-a^2 - 3aL - 2L^2)\right] \qquad (22)$$

Determination of the Normal and Shearing Stresses:

To compute the normal and shearing stresses at any point on the beam's cross section, the following classic equations can be utilized:

$$\sigma_x = \frac{-My}{I} \qquad (23)$$

$$\tau_{xy} = \frac{VQ}{Ib} \qquad (24)$$

In equation (24), the first moment of the area (Q) can be obtained using the following equation:

$$Q = \frac{b(h^2/4 - y^2)}{2} \qquad (25)$$

Determination of the Principal Stresses:

A square differential element of beam subjected to the normal stresses σ_x and σ_y and a shearing stress τ_{xy} is shown in Figure 4. To develop the expression for the principal normal and shearing stresses acting on the element of the beam, the equation for the normal stress σ and shearing stress τ on an inclined plane with an angle of inclination of θ are obtained first.

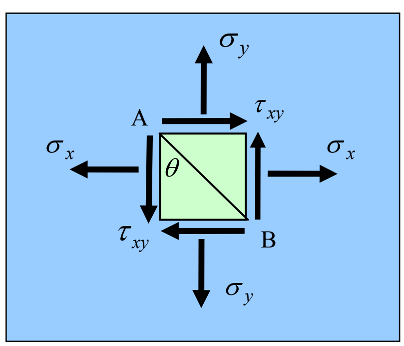


Figure 4. A Sketch of a Differential Element Subjected to Normal and Shearing Stresses

Using the differential wedge element shown in Figure 5 and writing the force equilibrium equations along the x' and y' directions:

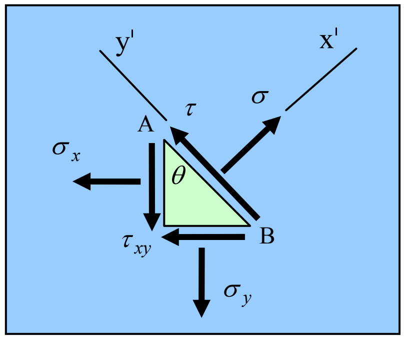


Figure 5. Free Body Diagram of the Wedge Element

$$\sigma = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos(2\theta) + \tau_{xy}\sin(2\theta) \tag{26}$$

$$\tau_{xy} = -\frac{\sigma_x - \sigma_y}{2}\sin(2\theta) + \tau_{xy}\cos(2\theta) \tag{27}$$

To obtain the principal stresses acting on the element, the derivatives of these equations with respect to θ are first set to zero and the obtained values of θ are then plugged back into Equations (26) and (27). The derived expressions for stresses are presented below:

$$\sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^{\ 2}} \tag{28}$$

$$\sigma_2 = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^{\ 2}} \tag{29}$$

$$\tau_1 = +\sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^{\ 2}} \tag{30}$$

$$\tau_2 = -\sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^{\ 2}} \tag{31}$$

IV. Development of the Virtual Instruments for the Project

Virtual Instruments for Determination of the Shear, Moment, Slope, and Deflection

Included in this section of the paper are the front panel and the block diagram for each one of the Virtual Instruments (VIs) developed for the sample problem presented in the paper. To obtain the distribution for shear, moment, slope, and deflection of the beam subjected to the combined loading presented in Figure 1(a); two separate VI's are first developed, one to analyze the beam subject to the distributed load, and the other to investigate the beam subjected to a concentrated lad. A third VI is developed next to call the first two VIs, combine the results, and determine the result for the combined load case.

Applied Distributed Load Case:

The front panel and block diagram of the Virtual Instrument developed for analyzing a beam subjected to a distributed load is presented in Figures 6 & 7. This VI utilizes a MATLAB program to perform the needed computations. The front panel shown in Figure 6 illustrates how the user can conveniently alter the beam and loading parameters to obtain the tabulated values of the shear, moment, slope, and deflection, and the corresponding plots. The block diagram of the problem presented in Figure 7 (a) illustrates how the data is obtained from the user and processed by an imported MATLAB script file to produce the tabulated results and needed distributions. The imported MATLAB program utilizes Equations (1-4) & (11-14) developed earlier in the paper to compute the needed results.

As noted from the block diagram illustrated in Figure 7 (a), the developed VI makes a call to a subVI that is designed to produce the needed plots. The block diagram of this subVI is presented in Figure 7 (b). The values of the distance x and the corresponding values of shear, moment, slope, and deflection are paired in the subVI to generate the plots.

Applied Concentrated Load Case:

The front panel and block diagram of the Virtual Instrument developed for analyzing a beam subjected to a concentrated load is provided in Figures 8 & 9. This VI computes the shear, moment, slope, and deflections of the beam by utilizing equations (15-22) and without employing a MATLAB program. This VI was originally developed in an earlier work of the author[2] and it is included here to show the some of the powerful graphical programming capabilities of LabVIEW. The block diagram in Figure 9 shows how two "for loops" are set up to compute the value of shear, moment, slope, and deflection at different values of x along the length of the bream in the two regions of the beam. The block diagram also illustrates how the data is read into the program and processed through different programming nodes of labVIEW to produce the tabulated values and the needed plots.

Applied Combined Load Case:

The Virtual Instrument for analyzing a beam subjected to a combined distributed and concentrated load can be obtained by utilizing the VIs previously developed for each of the applied loads. The front panel and block diagram of the VI obtained for the combined load case are presented in Figures 10 & 11. The block diagram in Figure 11 illustrates how the results from the two case can be superimposed using two specific functions of LabVIEW (the bundle & unbundle functions) to generate the data for the combined load case.

The tabulated values and the distribution of shear, moment, slope, and deflection along the length of the beam presented in problem 1 is provided in Figure 10.

Virtual Instrument for the Determination of the Principal Stresses:

The front panel and the block diagram of the Virtual Instrument developed for computing the principal stresses at point D on the cross section of the beam in Figure 1 (b) are provided in Figures 12 & 13. In the block diagram, an imported MATLAB script file is utilized to compute the shear force, bending moment, and the corresponding value of normal stress σ_x and shearing stress τ_{xy} at point D. Note that these stresses are computed utilizing equations (23-25). This VI next makes a call to a subVI entitled "Stress-Analysis" designed to compute the principal stresses acting on a differential element of the material. The front panel and the block diagram of the "Stress-Analysis" subVI was initially developed in an earlier work of the author[3] and is presented in Figures 14-15 for the sake of completeness. This subVI is designed in a way not only to compute the principal normal and shearing stresses acting on an element of the material, but also the normal and shearing stresses acting on any inclined plane. The computations for these stresses are performed utilizing equations (26-31). Note that additionally in this subVI provision has made so that if the principal normal stress or the principal shearing stress exceeds the allowable value of normal or shearing stress, a failure indicator on the front panel cautions the designer.

The values of the principal normal and shearing stresses acting at point D on the cross section of the beam presented in Figure 1(a) are provided in Figure 12.

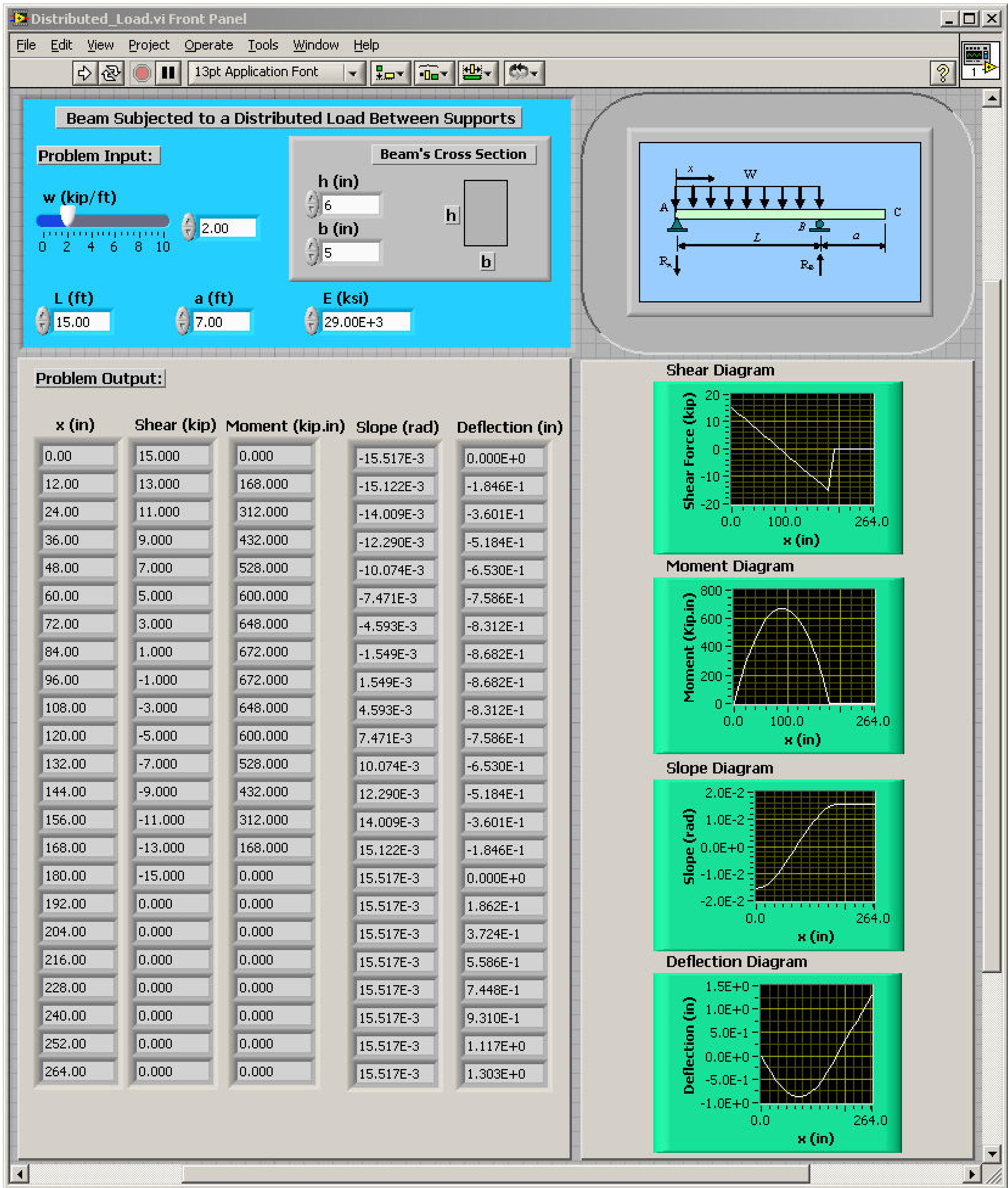


Figure 6. Front Panel of the VI Created for Analyzing
a Beam Subjected to a Distributed Load Acting Between Supports

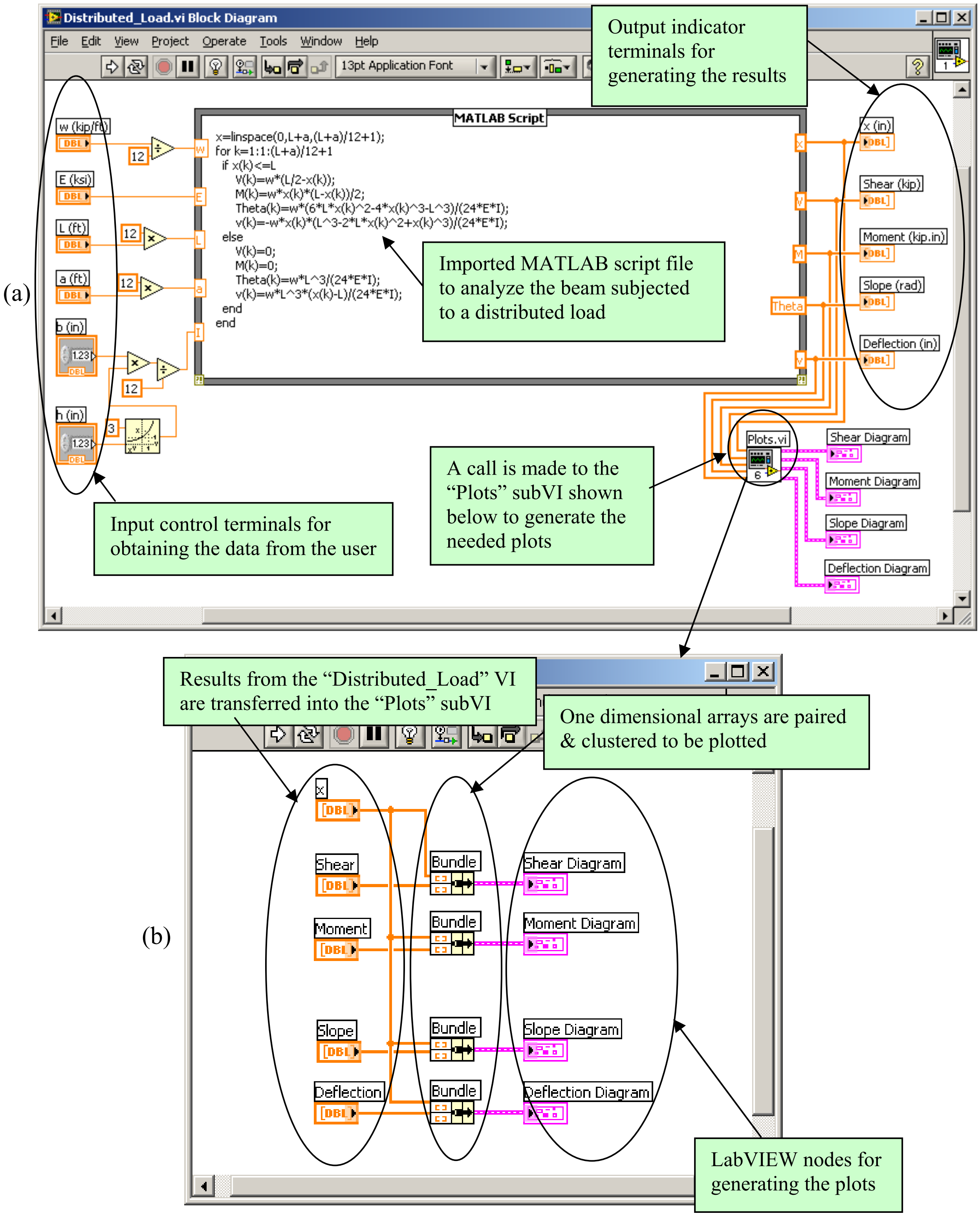
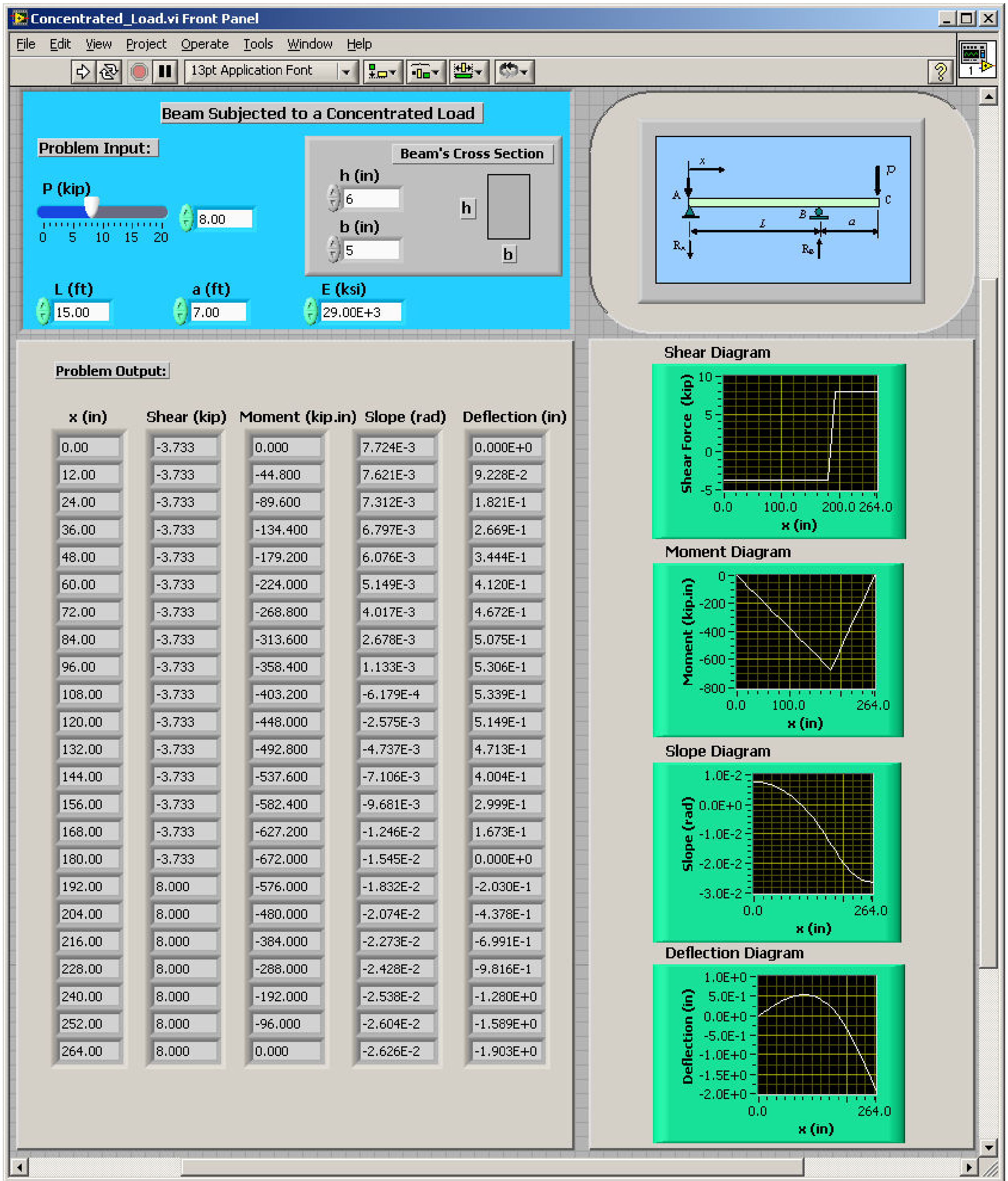


Figure 7. Block Diagrams of the VIs Created for Analyzing
a Beam Subjected to a Distributed Load Acting Between Supports



x (in)	Shear (kip)	Moment (kip.in)	Slope (rad)	Deflection (in)
0.00	-3.733	0.000	7.724E-3	0.000E+0
12.00	-3.733	-44.800	7.621E-3	9.228E-2
24.00	-3.733	-89.600	7.312E-3	1.821E-1
36.00	-3.733	-134.400	6.797E-3	2.669E-1
48.00	-3.733	-179.200	6.076E-3	3.444E-1
60.00	-3.733	-224.000	5.149E-3	4.120E-1
72.00	-3.733	-268.800	4.017E-3	4.672E-1
84.00	-3.733	-313.600	2.678E-3	5.075E-1
96.00	-3.733	-358.400	1.133E-3	5.306E-1
108.00	-3.733	-403.200	-6.179E-4	5.339E-1
120.00	-3.733	-448.000	-2.575E-3	5.149E-1
132.00	-3.733	-492.800	-4.737E-3	4.713E-1
144.00	-3.733	-537.600	-7.106E-3	4.004E-1
156.00	-3.733	-582.400	-9.681E-3	2.999E-1
168.00	-3.733	-627.200	-1.246E-2	1.673E-1
180.00	-3.733	-672.000	-1.545E-2	0.000E+0
192.00	8.000	-576.000	-1.832E-2	-2.030E-1
204.00	8.000	-480.000	-2.074E-2	-4.378E-1
216.00	8.000	-384.000	-2.273E-2	-6.991E-1
228.00	8.000	-288.000	-2.428E-2	-9.816E-1
240.00	8.000	-192.000	-2.538E-2	-1.280E+0
252.00	8.000	-96.000	-2.604E-2	-1.589E+0
264.00	8.000	0.000	-2.626E-2	-1.903E+0

Figure 8. Front Panel of the VI Created for Analyzing
a Beam Subjected to a Concentrated End-Load

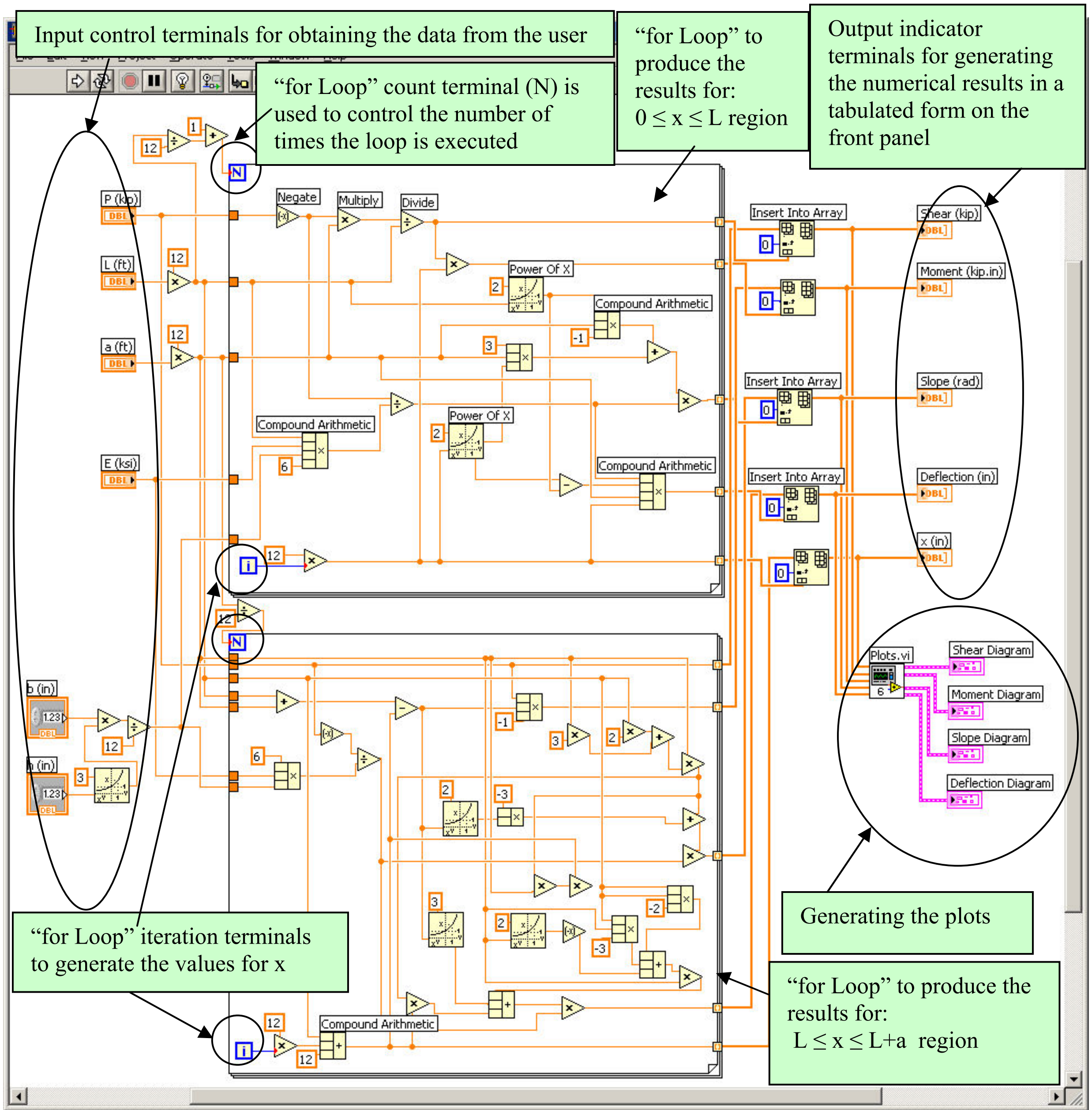
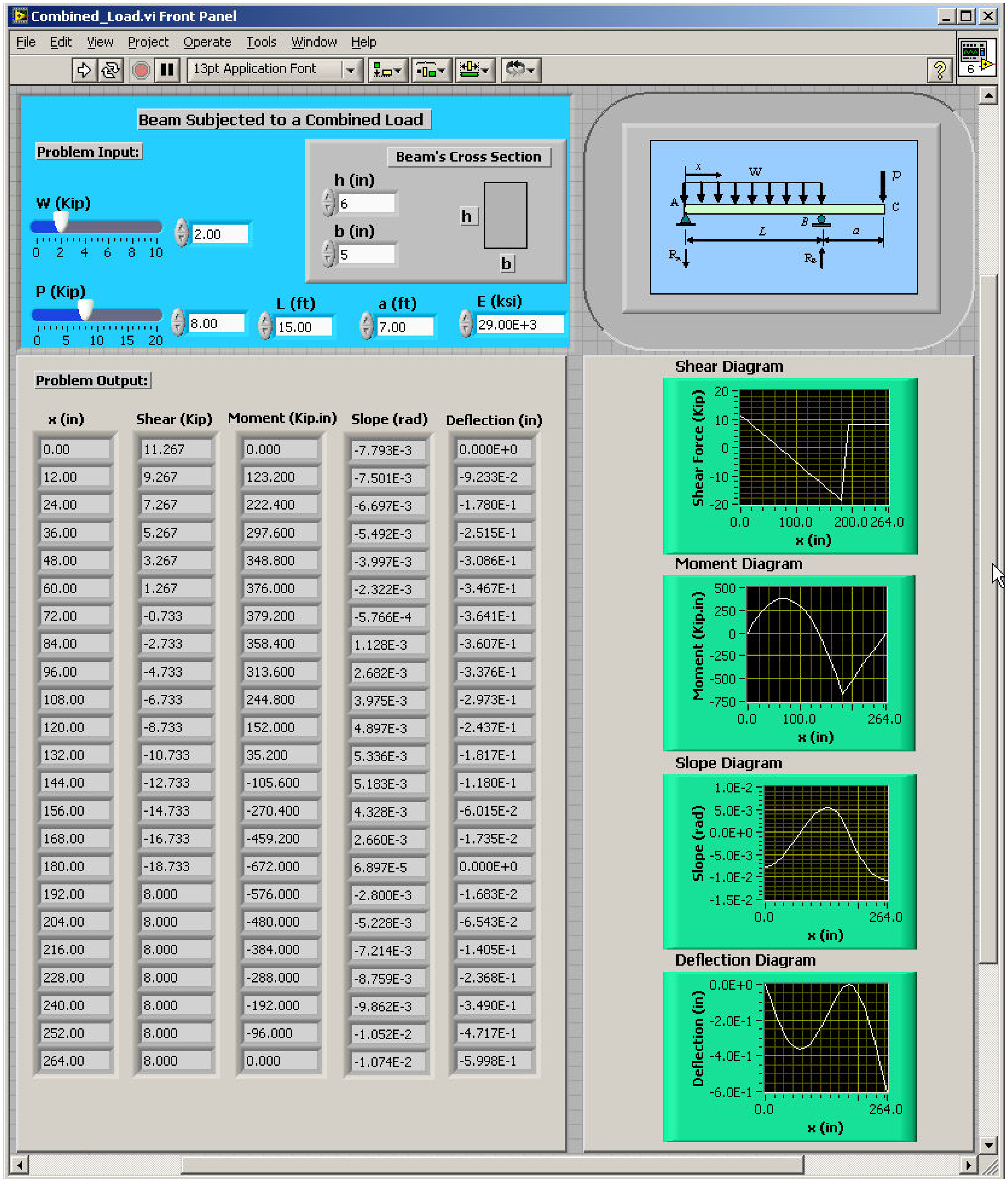


Figure 9. Block Diagram of the VI Created for Analyzing
a Beam Subjected to a Concentrated End-Load



x (in)	Shear (Kip)	Moment (Kip.in)	Slope (rad)	Deflection (in)
0.00	11.267	0.000	-7.793E-3	0.000E+0
12.00	9.267	123.200	-7.501E-3	-9.233E-2
24.00	7.267	222.400	-6.697E-3	-1.780E-1
36.00	5.267	297.600	-5.492E-3	-2.515E-1
48.00	3.267	348.800	-3.997E-3	-3.086E-1
60.00	1.267	376.000	-2.322E-3	-3.467E-1
72.00	-0.733	379.200	-5.766E-4	-3.641E-1
84.00	-2.733	358.400	1.128E-3	-3.607E-1
96.00	-4.733	313.600	2.682E-3	-3.376E-1
108.00	-6.733	244.800	3.975E-3	-2.973E-1
120.00	-8.733	152.000	4.897E-3	-2.437E-1
132.00	-10.733	35.200	5.336E-3	-1.817E-1
144.00	-12.733	-105.600	5.183E-3	-1.180E-1
156.00	-14.733	-270.400	4.328E-3	-6.015E-2
168.00	-16.733	-459.200	2.660E-3	-1.735E-2
180.00	-18.733	-672.000	6.897E-5	0.000E+0
192.00	8.000	-576.000	-2.800E-3	-1.683E-2
204.00	8.000	-480.000	-5.228E-3	-6.543E-2
216.00	8.000	-384.000	-7.214E-3	-1.405E-1
228.00	8.000	-288.000	-8.759E-3	-2.368E-1
240.00	8.000	-192.000	-9.862E-3	-3.490E-1
252.00	8.000	-96.000	-1.052E-2	-4.717E-1
264.00	8.000	0.000	-1.074E-2	-5.998E-1

Figure 10. Front Panel of the VI Created for Analyzing a Beam Subjected to a Combined Distributed & Concentrated Load

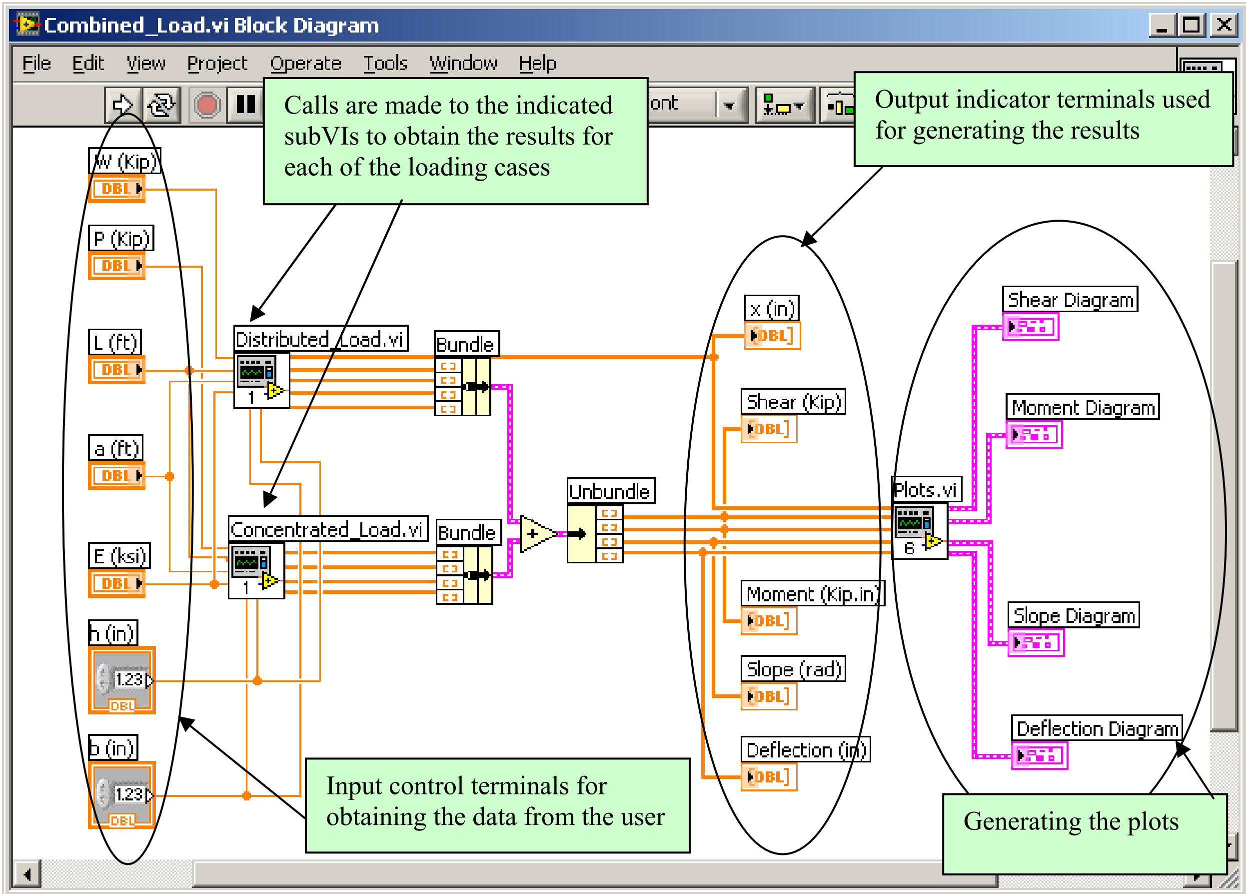


Figure 11. Block Diagram of the VI Created for Analyzing a Beam Subjected to a Combined Distributed & Concentrated Load

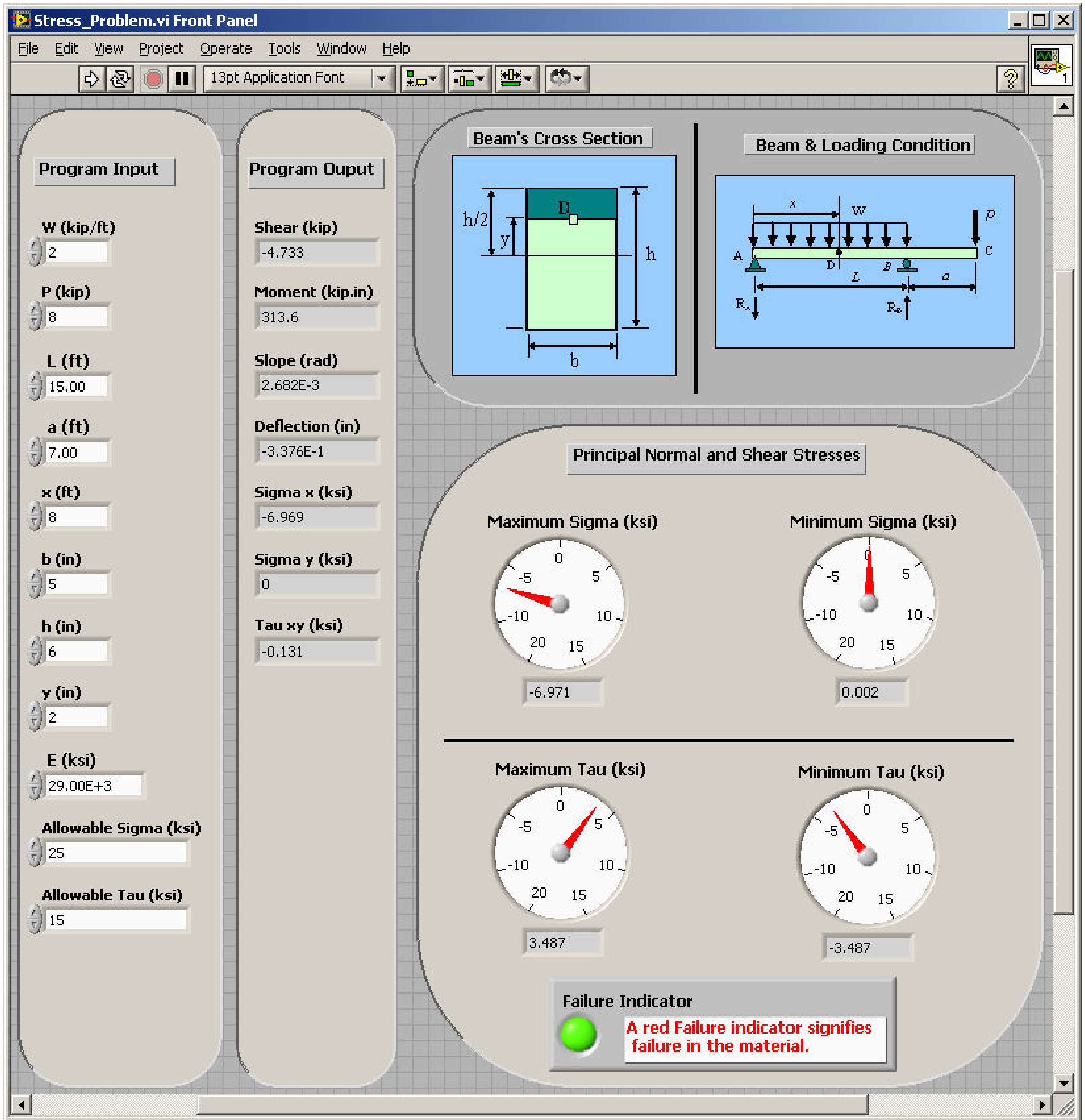


Figure 12. Front Panel of the VI Created for Computing the Principal Stresses at Point D Located on the Beam

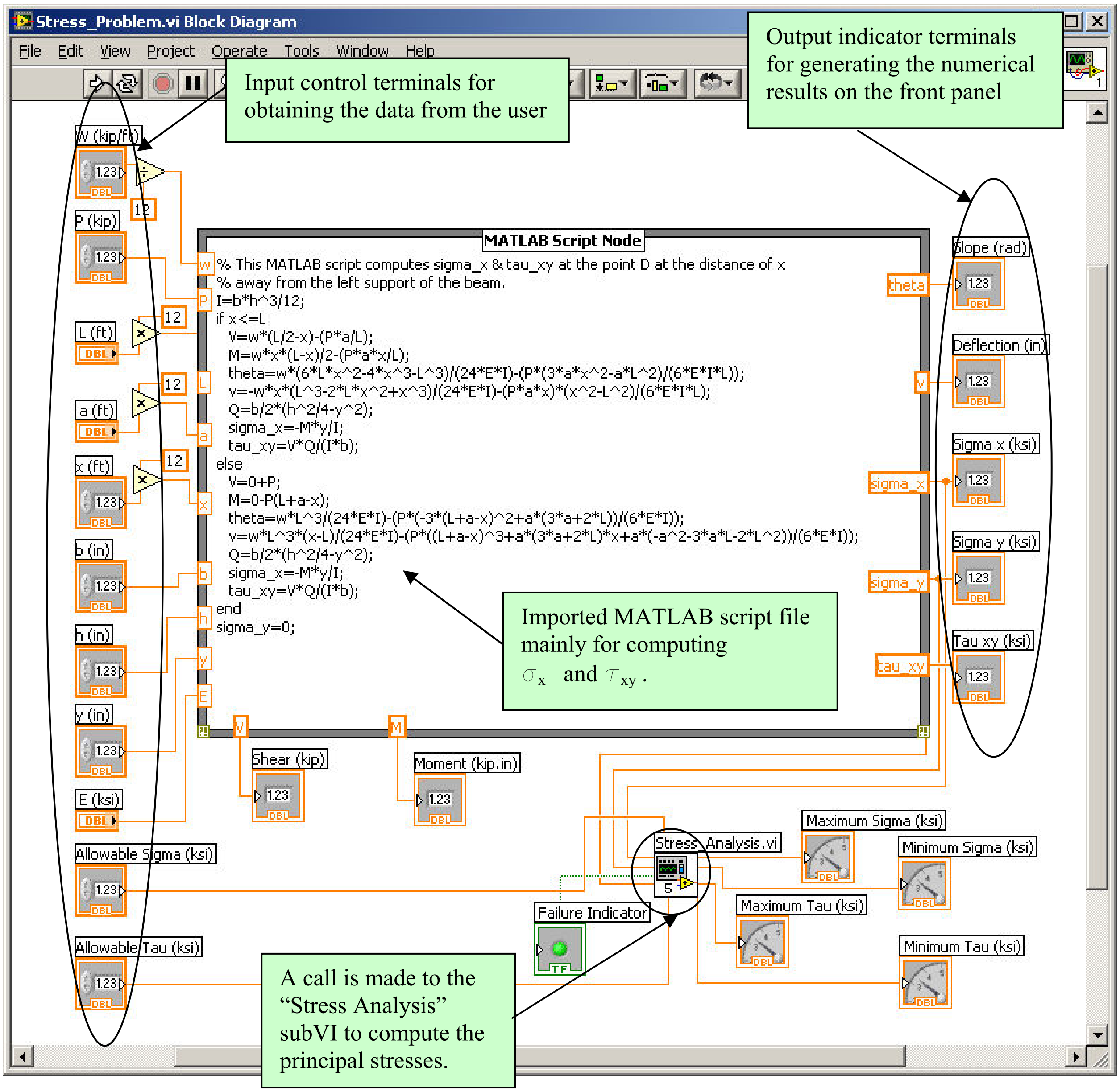


Figure 13. Block Diagram of the VI Created for Computing the Principal Stresses at Point D Located on the Beam

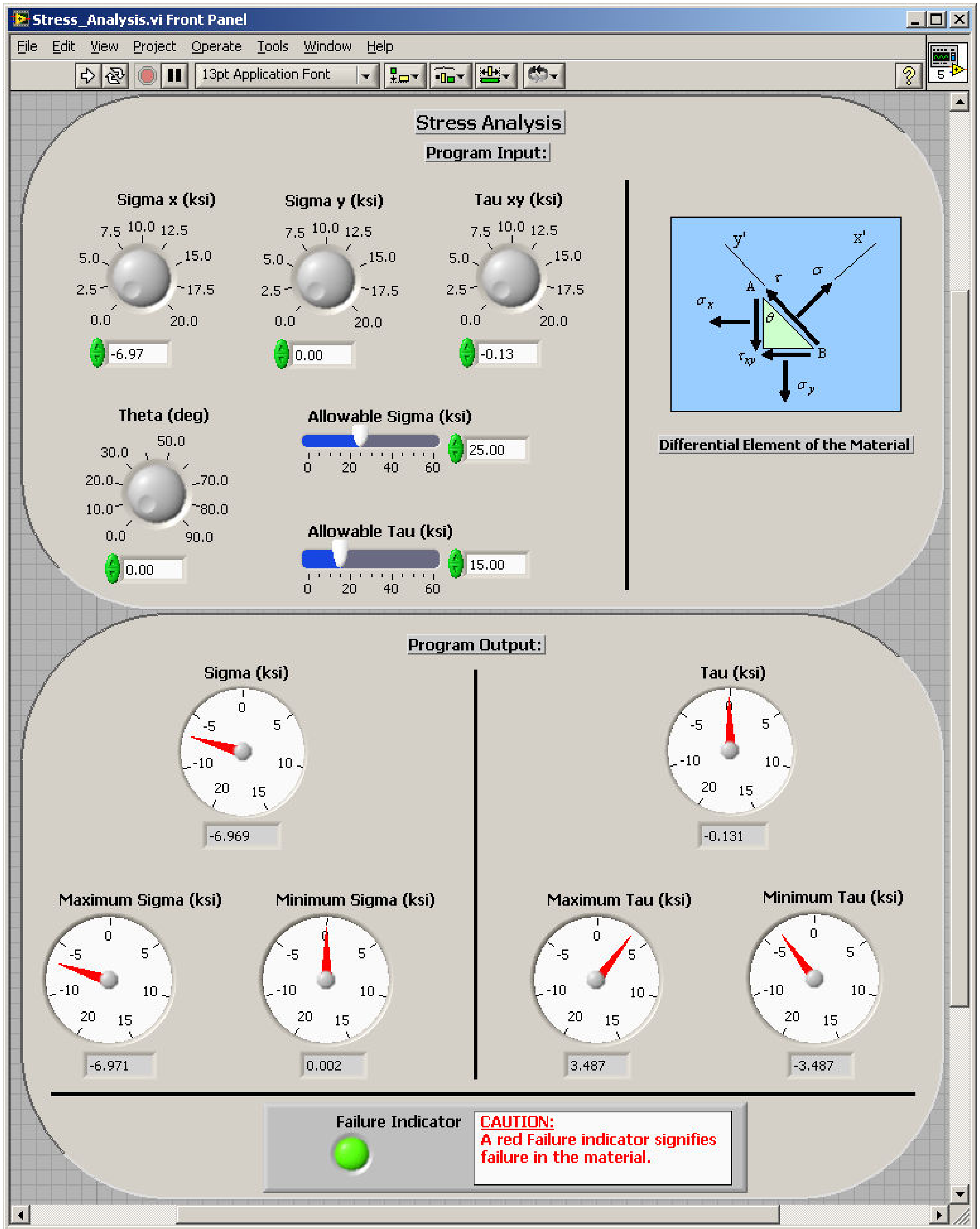


Figure 14. Front Panel of a General VI Created for Analyzing the Stresses Acting on an Element of the Material on the Beam

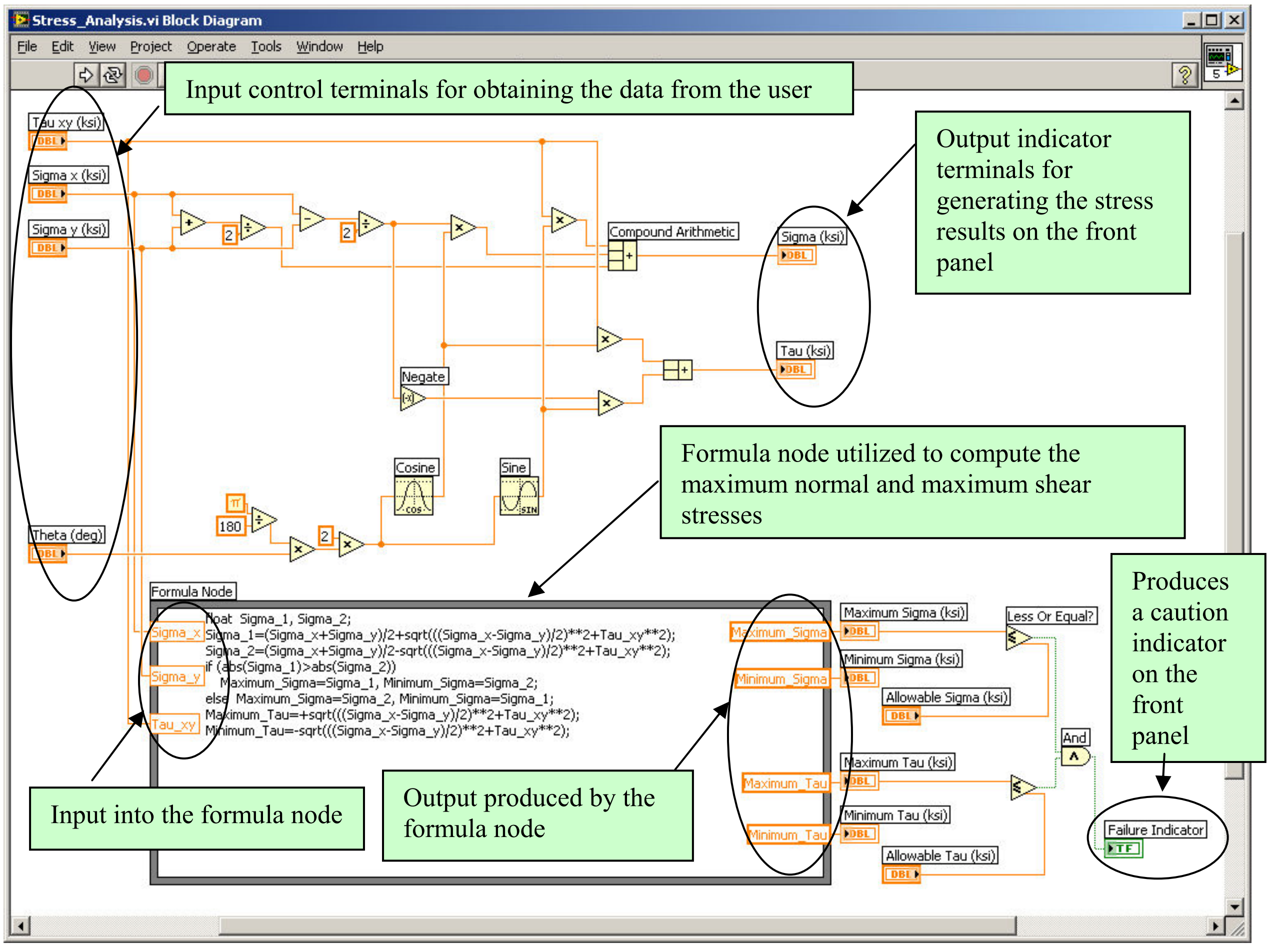


Figure 15. Front Panel of a General VI Created for Analyzing the Stresses Acting on an Element of the Material on the Beam

IV. Summary & Conclusion

In the presented paper a methodology is presented for further enhancing the educational experience of sophomore engineering and engineering technology students utilizing undergraduate projects. The seven important phases of this project, along with their benefits, are also outlined in the paper. Included in the paper is also a sample problem to show the type of activities the students will be involved in, and to further illustrate how these activities can contribute to the academic development of the students. This particular project involves the development of MATLAB script files and LabVIEW Virtual Instruments for solving several Mechanics of Materials problems. Depending upon the academic background and capabilities of the students, the degree of difficulty and the extent of the project can be adjusted. The LabVIEW Virtual Instruments developed in the project can be used as an effective educational tool to further enhance the students understanding of the subject matter. The student can conveniently alter the problem input and analyze and interpret the obtained results. The effectiveness of this project can be evaluated by tracking the academic success of the students in their future studies and professional careers. The proposed methodology enhances the interest of students in performing research, and encourages them to possibly pursue graduate studies.

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