

Shear and Moment Diagrams

Introduction

This tool guides you through a two-step process.

- You can pose a beam problem through an easy-to-learn user interface.
- You get systematic and structured instructions for drawing the shear and bending-moment diagrams for the loaded beam.

You are using the “Statics” version of the tool, that can analyze determinate beams only – beams supported with either two simple supports or one clamped support. The other limitation is that the distributed loads can be uniform or linear.

Workspace

When you open the shear-moment tool, you get a window as shown in Figure-1.



Figure-1: Workspace

You pose a problem by clicking on the “Input/Beam Parameters” button.

Step-2: The “Solve/Analyze Beam” button guides you through the analysis.

The “About” button takes you to a website where you can read/download this manual or watch a movie demonstrating the use of this tool. The “Exit” button terminates the program.

Example-1

You want to draw the shear and bending-moment diagrams for the simply-supported beam of Figure-2.

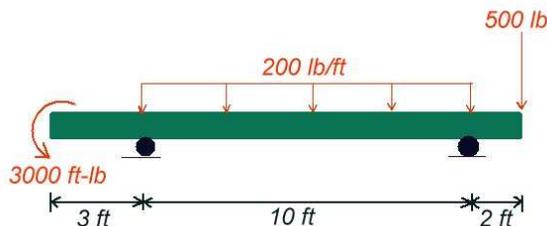


Figure-2: Example-1

Click “Input/Beam Parameters” - You will get the window of Figure-3.



Figure-3: Beam Parameters

Select “English” units.

Click “Beam Geometry” – You will get the window of Figure-4.

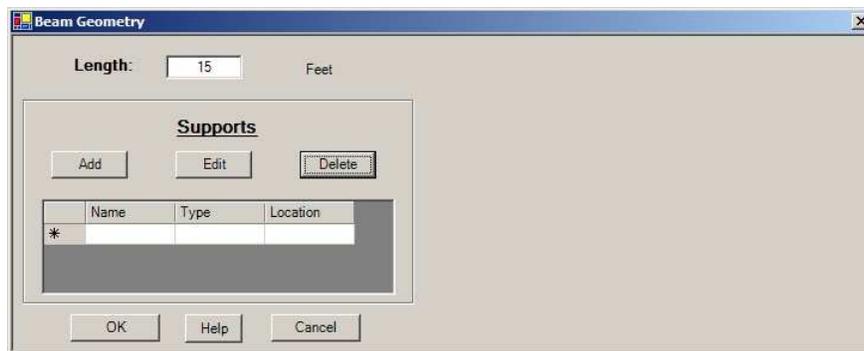


Figure-4: Beam Geometry

Enter “Length” as 15 feet.

Click “Add” to add a support – You will get the window of Figure-5

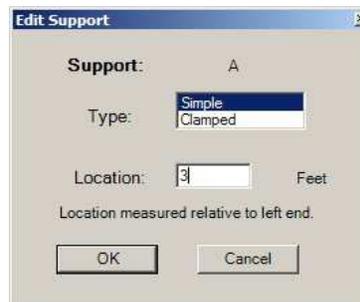


Figure-5: Adding Support

Select support “Type” as “Simple”.

Enter “Location” as 3 feet.

Click “OK” – You will be back to the window of [Figure-4](#).

Click “Add” to enter the “Type” (simple) and “Location” (13) of the 2nd simple support.

Click “OK” – You will get the window of Figure-6 showing the beam geometry.

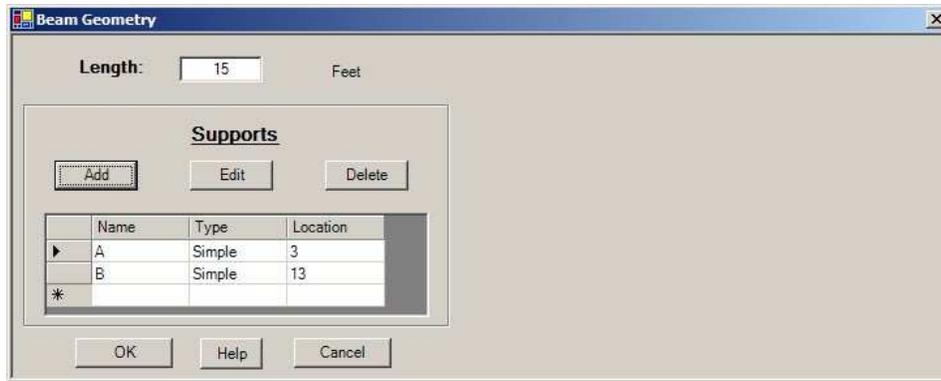


Figure-6: Updated Beam Geometry

Click “OK” – You will be back to the window of Figure-3.

Click “Forces/Moments” to add the loading – You will get the window of Figure-7.

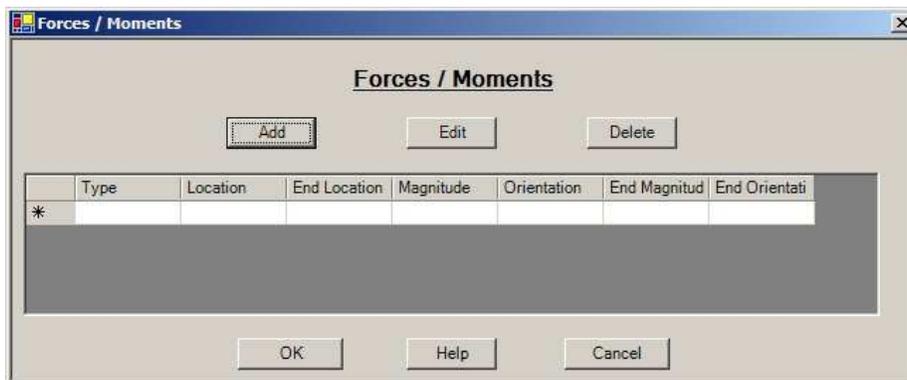


Figure-7: Forces and Moments

Click “Add” to include the 3000 ft-lb moment – You will get the window of Figure-8.



Figure-8: Adding couple

Select “Type” as “Couple”.

Select “Orientation” as counter-clock-wise (“CCW”).

Enter “Magnitude” as 3000.

Enter “Location” as 0.

Click “OK” – You will be back to updated “Forces/Moments” window of Figure-9.

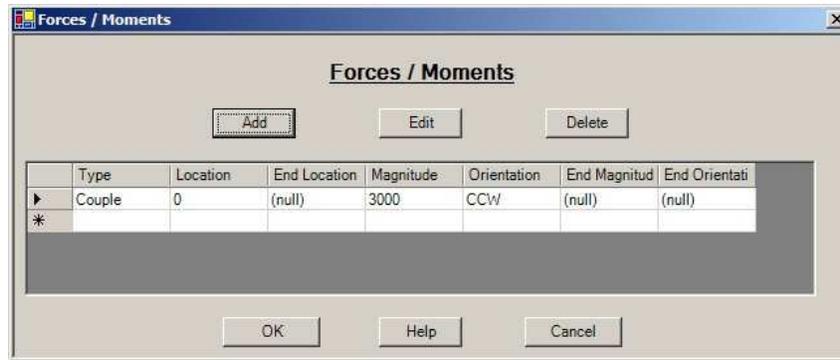


Figure-9: Couple added.

Click “Add” to include the 200 lb/ft uniform distributed load – You will get the window of Figure-10.

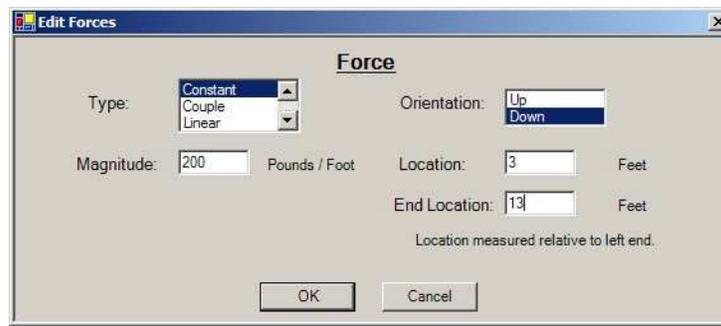


Figure-10: Adding distributed load

Select “Type” as “Constant”.
 Select “Orientation” as “Down”.
 Enter “Magnitude” as 200.
 Enter start “Location” as 3.
 Enter “End Location” as 13.
 Click “OK” – You will be back to the updated “Forces/Moments” window of Figure-11.



Figure-11: Couple and distributed load added.

Click “Add” to include the 500 lb point load – You will get the window of Figure-12.

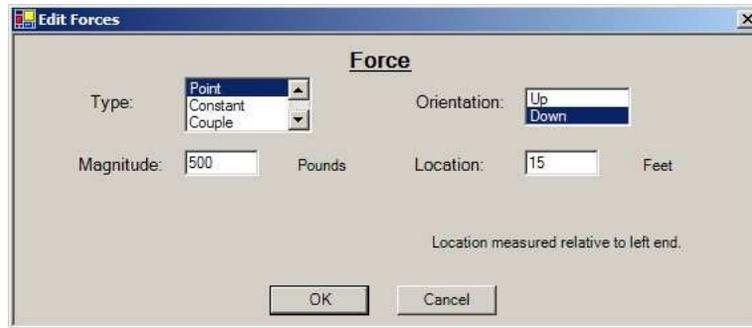


Figure-12: Adding point load

Select “Type” as “Point”.
 Select “Orientation” as “Down”.
 Enter “Magnitude” as 500.
 Enter “Location” as 15.
 Click “OK” – You will be back to the updated “Forces/Moments” window of Figure-13.



Figure-13: Couple, distributed load, and point load added.

Click “OK” – You will be back to the window of Figure-3.
 You can save this problem by clicking on “Save” or “Save As” buttons. You can open previously saved problems by clicking the “Open” button. You can terminate the session by clicking the “Cancel” button.

Click “OK” – You will be back to the updated window of Figure-1. This window will now include the problem definition as shown in Figure-14.

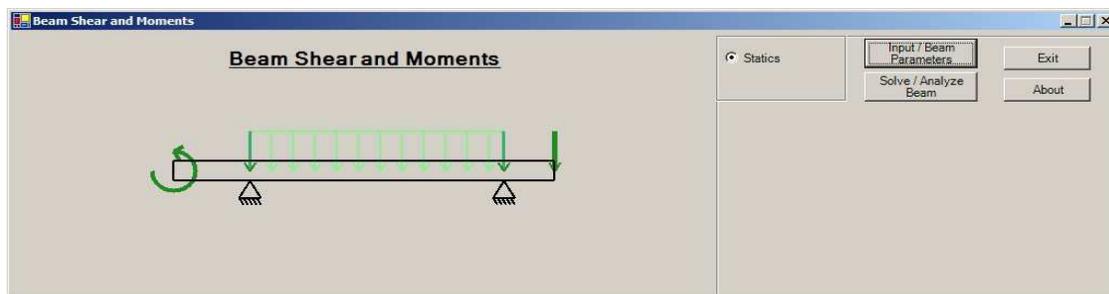


Figure-14: Problem definition.

Click “Solve/Analyze Beam” for the tool to guide you through the solution process – You will get the window of Figure-15.

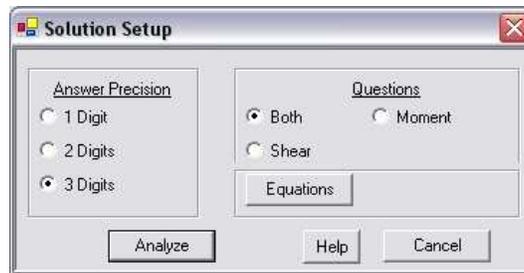


Figure-15: Solve/Analyze set-up.

You can select the accuracy of the solution, in number of digits, by using the radio buttons. When you click the “Equations” button, you get the algebraic expressions of the shear and bending-moment over the entire beam.

Select 3-digit accuracy.

Select “Both” to analyze shear AND bending–moment.

Click “Analyze” – You will get the window of Figure-16 for support analysis.

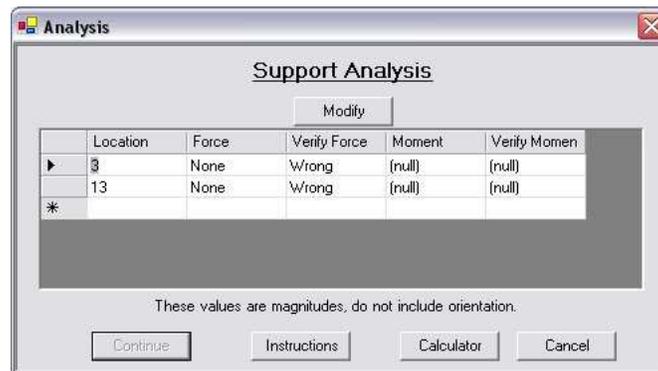


Figure-16: Support Analysis

The support reactions are calculated from the equilibrium of the entire beam. You can get help in writing the equilibrium equations by clicking the “Instructions” button.

To enter the support reactions in the window of Figure-16: Select a row by clicking on the row on the extreme left (grey) column.

Click on “Modify”.

Enter magnitude of reaction forces from the support – When you enter correct values of the reaction forces, you will get the window of Figure-17.

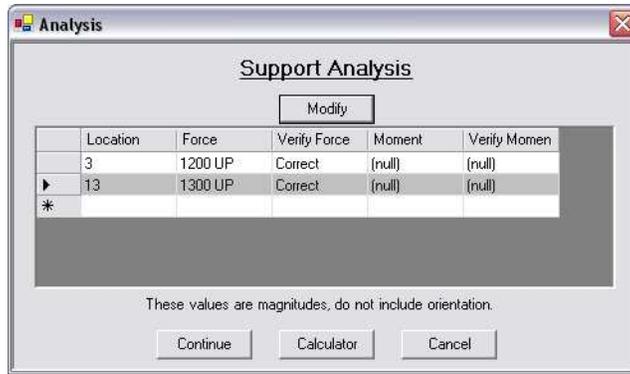


Figure-17: Support Reactions

Click “Continue” – You will get the window of Figure-18.

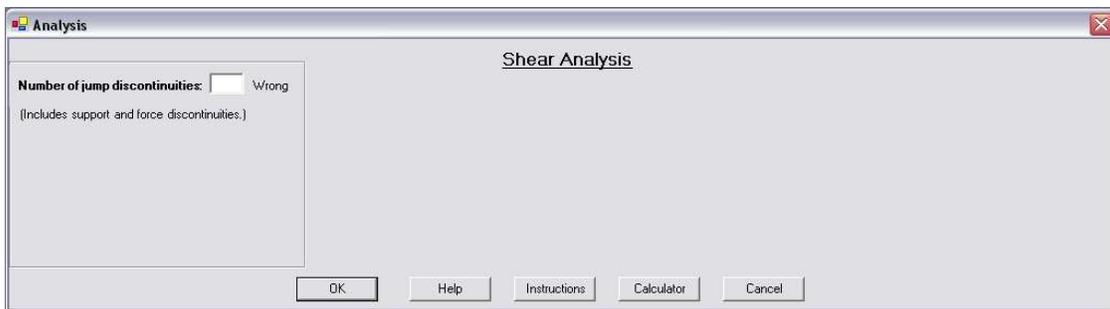


Figure-18: Shear Analysis, step-1.

Enter the number of jump discontinuities in loading. The jump discontinuities in the shear diagram are caused by the applied point forces and the reaction forces from the supports.

Click on “Instructions” for help on entering the data on the Windows of Figure-18 and Figure-19.

In the present problem, you have three discontinuities – two point forces from the supports and one from the loading. Thus, you enter 3 for discontinuities and enter their locations as 3, 13, and 15 by clicking the “Modify” button. When you enter correct discontinuity information, you will get the window of Figure-19.

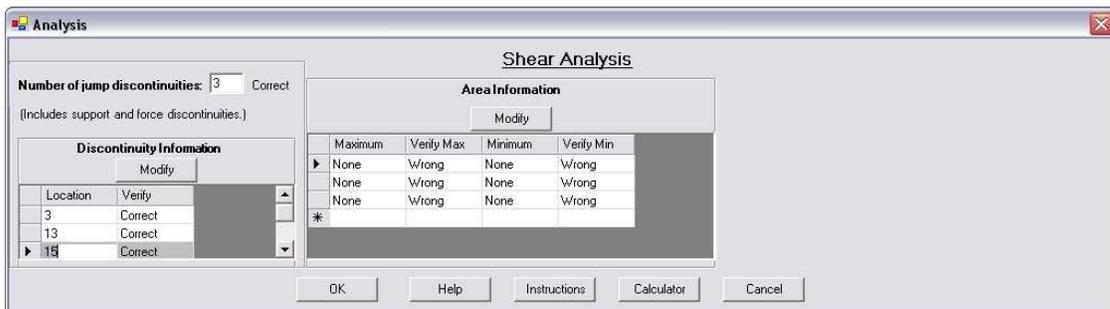


Figure-19: Shear Analysis, step-2.

The discontinuities partition the beam into three segments: (i) 0 to 3, (ii) 3 to 13, and (iii) 13 to 15. The three rows in the “Area Information” section correspond to these three segments, counted from the left end of the beam. For each segment, you enter the maximum and minimum values of shear (with +/- signs) by clicking on the “Modify” button. When these values are entered correctly, you will get the window of Figure-20.

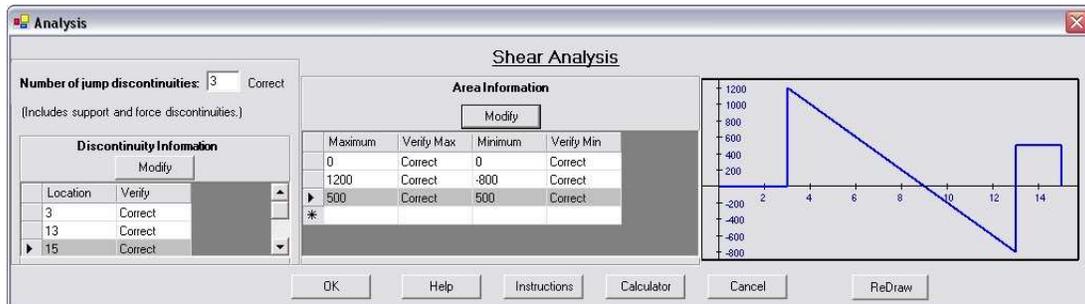


Figure-20: Shear Diagram.

Click “OK” to continue to the bending-moment diagram window. On this window, enter the number of jump discontinuities in loading. The jump discontinuities in the bending-moment diagram are caused by the applied moments and the reaction moment from a clamped support.

In the present problem, you have one discontinuity – the moment applied at the left end of the beam. Thus, you enter 1 for discontinuities and enter its location as 0 by clicking the “Modify” button. When you enter correct discontinuity information, you will get the window of Figure-21.

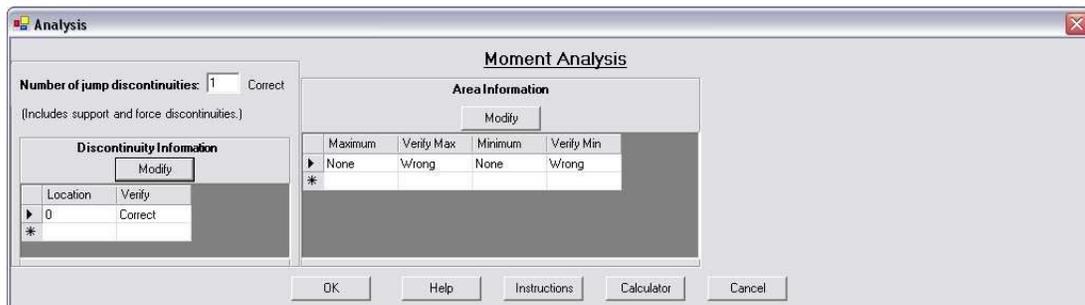


Figure-21: Moment Analysis

Click on “Instructions” for help on entering the data on the Windows of Figure-21 and Figure-22.

The discontinuities partition the beam into one segment: 0 to 15. The row in the “Area Information” section corresponds to this segment. For this segment, you enter the maximum and minimum values of the bending-moment (with +/- signs) by clicking on the “Modify” button. When these values are entered correctly, you get the window of Figure-22.

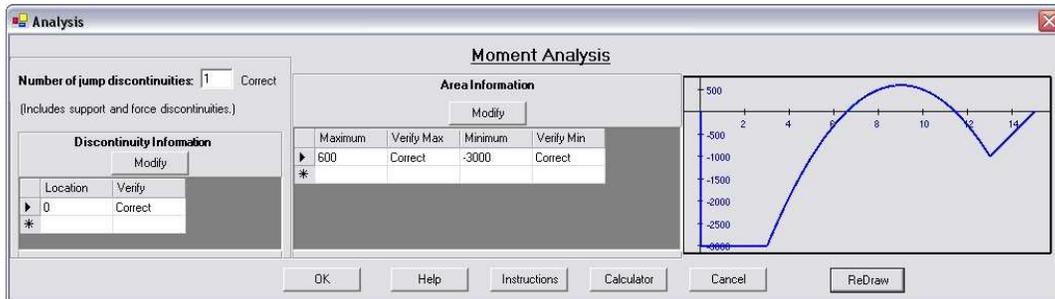


Figure-22: Bending-Moment Diagram.

Example-2

You want to draw the shear and bending-moment diagrams for the clamped beam of Figure-23.

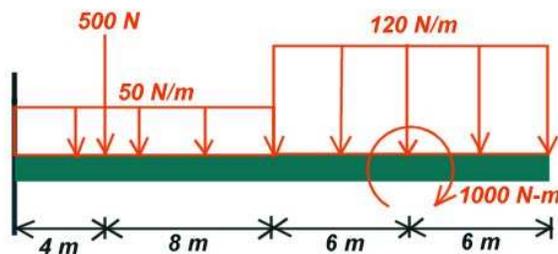


Figure-23: Example-2

On the window of Figure-3: Select “SI” units.

Click “Beam Geometry”.

On the window of Figure-4: Enter length as “24”.

On the window of Figure-4: Click “Add” to enter support information (type = clamped, and location = 0) – You will get the window of Figure-24.

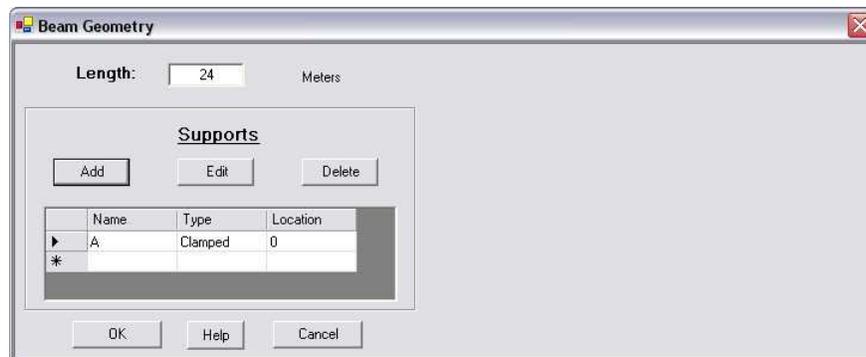


Figure-24

Click “OK” – You will be back to the window of Figure-3.

Click “Forces/Moments” to add loading – You will get the window of Figure-7.

On the window of Figure-7: “Add” the “Type” and “location” of the loading – You will get the window of Figure-25.

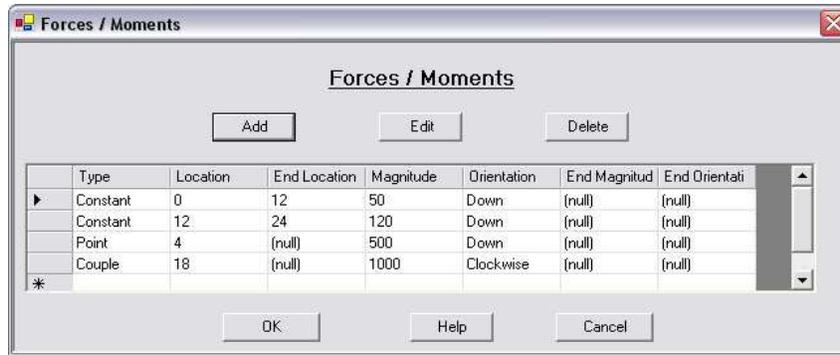


Figure-25

Click OK on window of Figure-25 – You will be back to the window of Figure-3.
 Click OK on window of Figure-3 – you will be back to window of Figure-1.
 This window will now include the problem definition as shown in Figure-26.

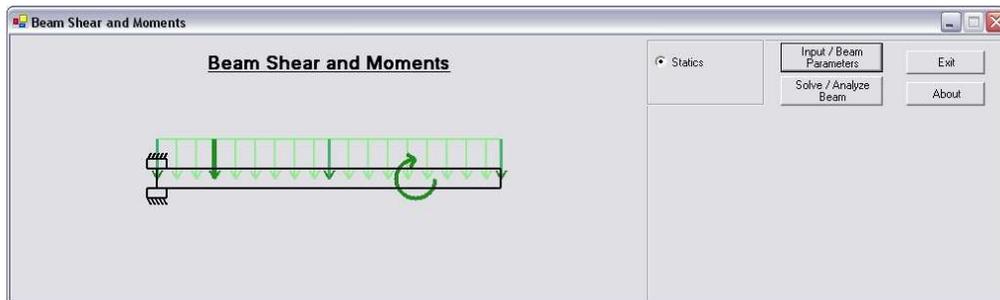


Figure-26

Click “Solve/Analyze” – You will get the window of Figure-15.
 Select 3-digit accuracy
 Select “Both” to analyze shear AND bending –moment
 Click “Analyze” – You will get the window of Figure-16 for support analysis.

The support reactions are calculated from the equilibrium of the entire beam. You can get help in writing the equilibrium equations by clicking the “Instructions” button.

On the window of Figure-16: Click “Modify”.
 Enter the reaction force and the reaction moment at the clamped support – You will get the window of Figure-27.

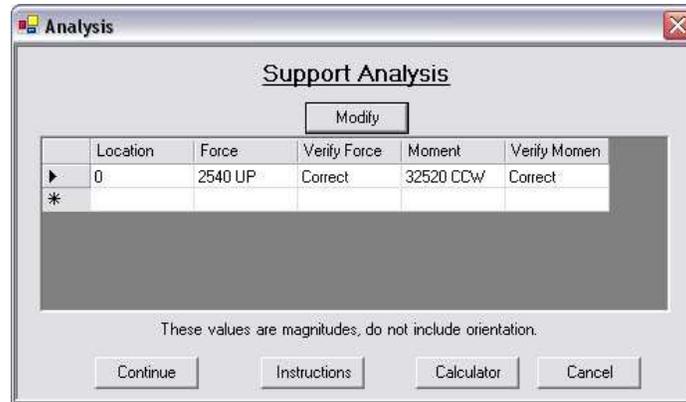


Figure-27

Click “Continue” – You will get the window of Figure-18.

Enter the number of jump discontinuities as 2: The 500N applied load and the 2540N reaction load.

Enter the locations of these discontinuities as 0 and 4, by using the “Modify” button – You will get the window of Figure-28.

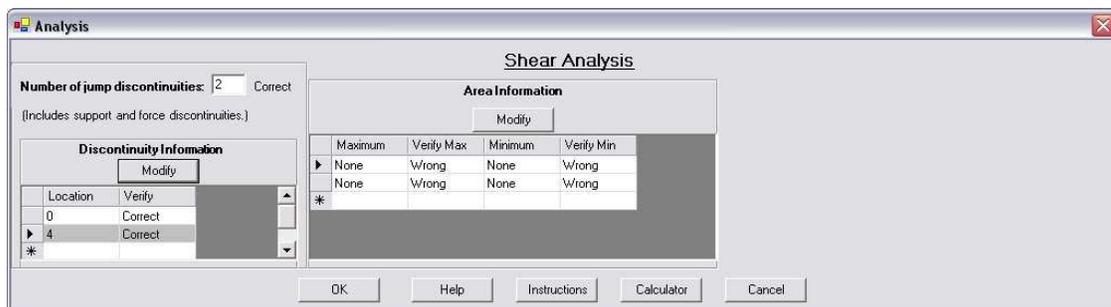


Figure-28

Click on “Instructions” for help on entering the data on the Window of Figure-28.

The jump discontinuities partition the beam into two segments: (i) 0 to 4 and (ii) 4 to 24. “Modify” the maximum and minimum values of shear in these two segments. When these values are entered correctly, you get the window of Figure-29.

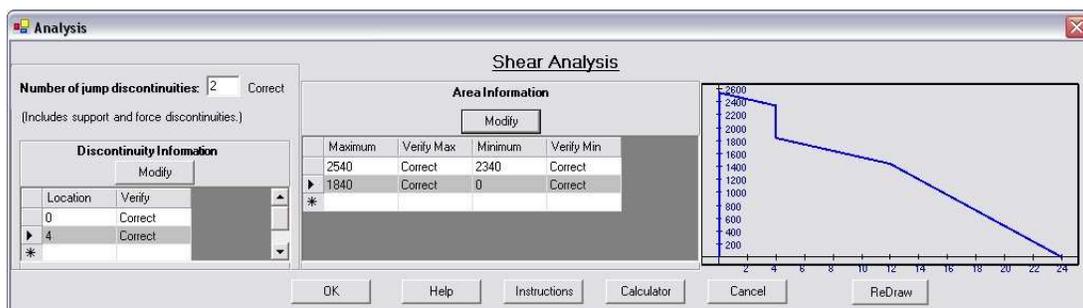


Figure-29

Click “OK” to proceed to the Moment Analysis window of Figure-21.

Enter the number of jump discontinuities as 2: The 1000N-m applied moment and the 32,520N-m reaction moment.
 Enter the locations of these discontinuities as 0 and 18, by using the “Modify” button – You will get the window of Figure-30.

Click on “Instructions” for help on entering the data on the Window of Figure-30.

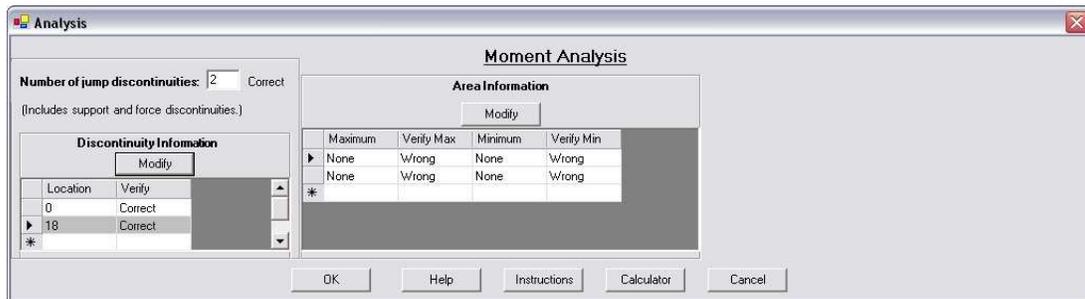


Figure-30

The jump discontinuities partition the beam into two segments: (i) 0 to 18 and (ii) 18 to 24.
 “Modify” the maximum and minimum values of moment in these two segments. When these values are entered correctly, you will get the window of Figure-31.

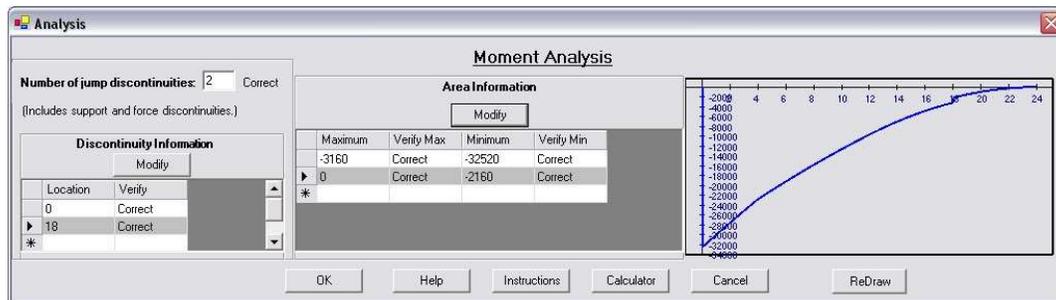


Figure-31