Beam Analysis Application – Overview

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Download Link

Overview

This application is a comprehensive tool for analyzing and designing beam structures. It is intended for civil and mechanical engineers, architects, students, and professionals who need to calculate, visualize, and document beam responses under various loading and support conditions. The app provides an intuitive interface, step-by-step calculation transparency, and export options for documentation and further study.

What the App Does

- **Beam Modeling:** Easily create and customize beams with any length, support configuration, and material properties.
- **Support Placement:** Add, remove, and configure supports (pinned, roller, fixed, spring) at any position along the beam.
- **Load Application:** Apply point loads, uniformly distributed loads (UDL), and varying distributed loads (VDL) anywhere on the beam.
- **Analysis:** Instantly calculate reactions, shear force diagrams (SFD), bending moment diagrams (BMD), and deflections.
- **Step-by-Step Calculations:** View detailed calculation steps for transparency and learning.
- **Export Results:** Export diagrams, calculation steps, and data to PDF or Excel for reporting and sharing.
- **User Guidance:** Access a comprehensive user guide and legend directly within the app.

Key Features

1. Beam Setup and Presets

- **Custom Beam:** Define beams of any length with your choice of supports and loads.
- **Preset Beams:**
    - **Simply Supported Beam:** Pin and roller supports at both ends.
    - **Cantilever Beam:** Fixed support at one end, free at the other.
    - **Fixed-Fixed Beam:** Fixed supports at both ends.
    - **Overhanging Beam:** Supports placed inside the beam span, with overhanging ends.
    - **Propped Cantilever:** Fixed at one end, roller at the other.
- **Material and Section Properties:** Set material type (e.g., steel, concrete) and section properties (area, moment of inertia).

2. Supports

- **Pin Support (PS):** Allows rotation, restricts translation.
- **Roller Support (RS):** Allows horizontal movement, restricts vertical movement.
- **Fixed Support (FS):** Restricts both rotation and translation.
- **Spring Support (SS):** Elastic support with specified stiffness.

3. Loads

- **Point Load (PL):** Concentrated force at a specific location.
- **Uniformly Distributed Load (UDL):** Constant force per unit length over a segment.
- **Varying Distributed Load (VDL):** Linearly varying force over a segment.
- **Load Direction:** Specify angle (0°, 90°, 180°, 270°); 90° is upward, 270° is downward for quick reference.

4. Calculation and Visualization

- **Instant Analysis:** Calculate reactions, shear, moment, and deflection with one click.
- **Diagrams:** Visualize SFD and BMD directly on the main interface.
- **Step-by-Step Solution:** Detailed breakdown of all calculations, including equilibrium equations and diagram construction.
- **Legend Panel:** Always-visible legend explains all symbols, load directions, and support types for quick reference.

5. Units and Settings

- **Units:** Choose from metric (m, kN, N·m, etc.) or imperial (ft, lbf, lb·ft, etc.) units for all inputs and outputs.
- **Unit Conversion:** Switch units at any time; values are automatically converted.

6. Export and Documentation

- **Export Diagrams:** Save SFD/BMD as images for reports or presentations.
- **Export to PDF:** Generate a PDF report including diagrams, calculation steps, and summary.
- **Export to Excel:** Save input data and results in Excel format for further analysis or record-keeping.

7. User Assistance

- **User Guide:** Comprehensive help window listing all shortcuts, beam types, supports, loads, legends, and units.
- **Legend:** Quick-access legend for all symbols and conventions.
- **Keyboard Shortcuts:** Speed up workflow with intuitive shortcut keys.

Keyboard Shortcuts

Shortcut	Action
Ctrl + L	Load from Excel
Ctrl + S	Save to Excel
Ctrl + P	Export Diagrams
Ctrl + D	Export Steps to PDF
Ctrl + T	Toggle Theme
Ctrl + M	Open Units Settings
Ctrl + U	Open User Guide
Ctrl + R	Reset Application
Ctrl + Q	Exit Application

Legend (Symbols and Directions)

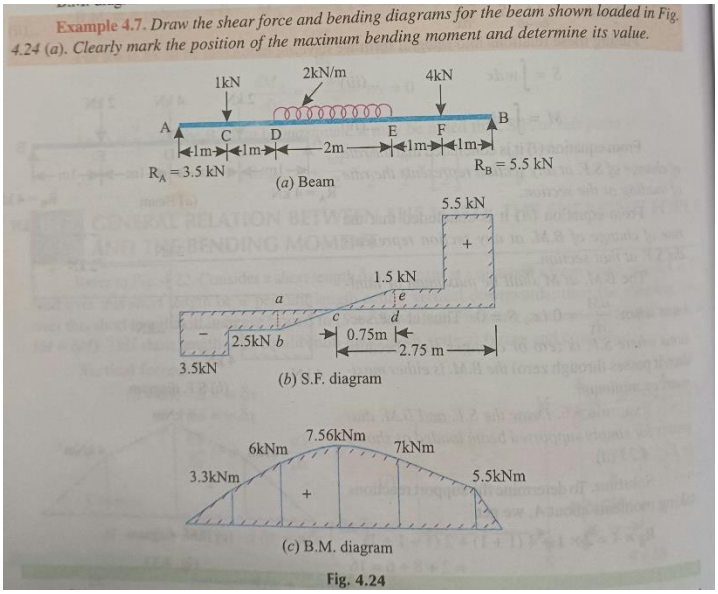
Abbreviation	**Meaning**
PS	Pin Support
RS	Roller Support
FS	Fixed Support
SS	Spring Support
PL	Point Load
UDL	Uniform Distributed Load
VDL	Varying Distributed Load
Angle 90°	Upward Load
Angle 270°	Downward Load

Units Supported

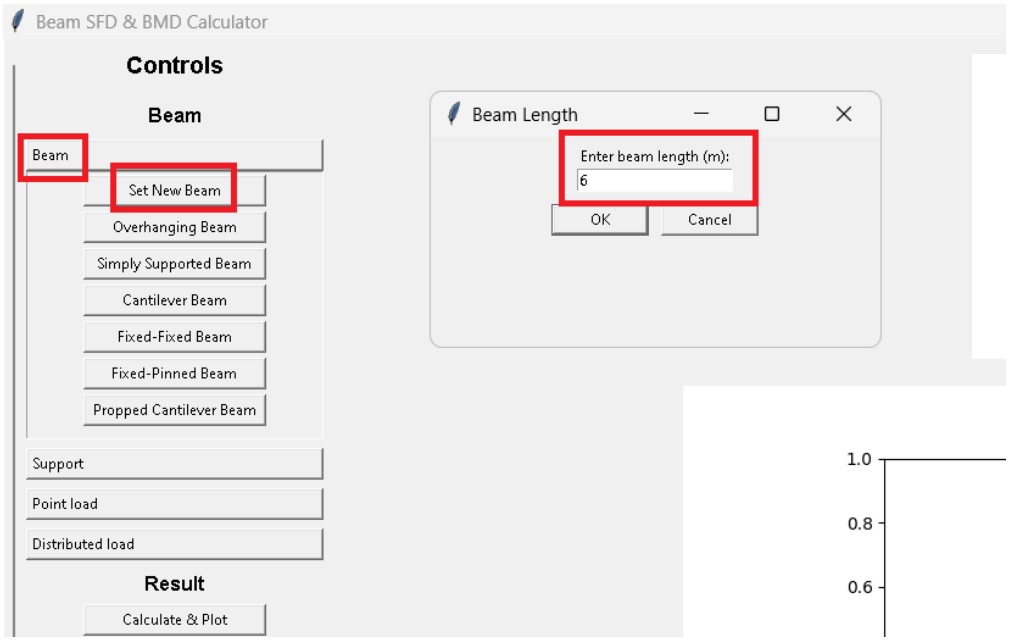
Quantity	Supported Units
Length	meter (m) centimetre (cm) millimetre (mm) inch (in) foot (ft) yard (yd) mile (mi)
Force	newton (N) kilonewton (kN) meganewton (MN) pound-force (lbf) kip
Moment	N·m N·mm kN·m lb·ft kip·ft
Angle	degree (°) radian (rad) gradian (gon)

Workflow Example: Solving a Textbook Problem

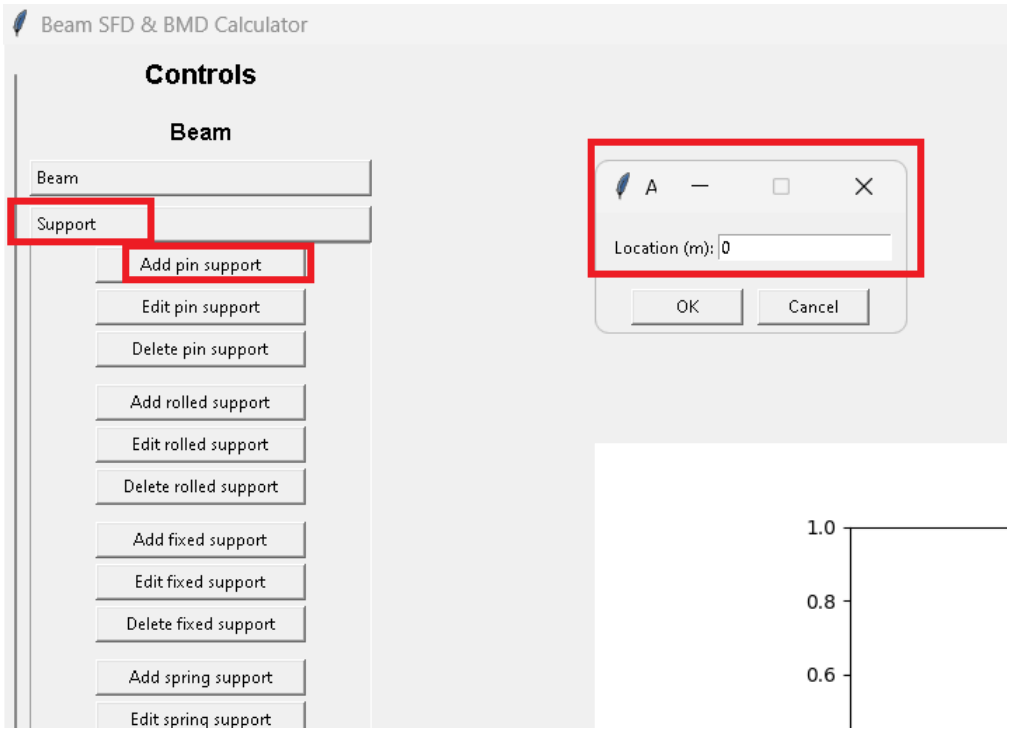
- **Textbook Problem:** Er. R.K. RAJPUT STRENGTH OF MATERIALS [MECHANICS OF SOLIDS] CHAPTER : 4 : BENDING MOMENTS AND SHEAR FORCES PAGE 222

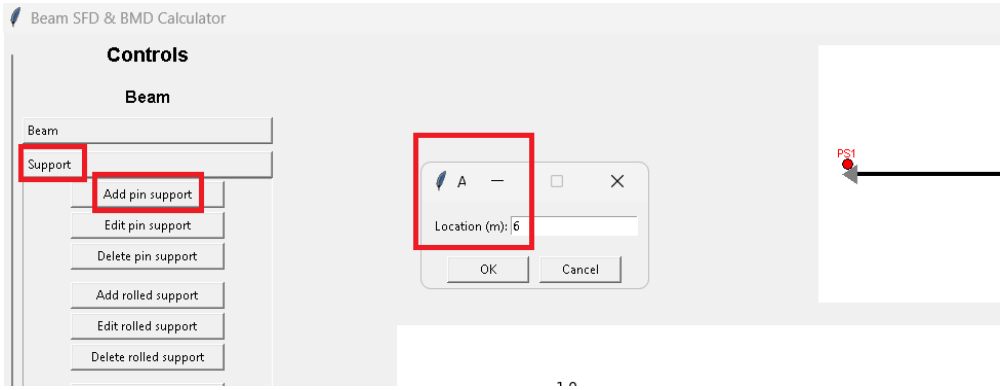


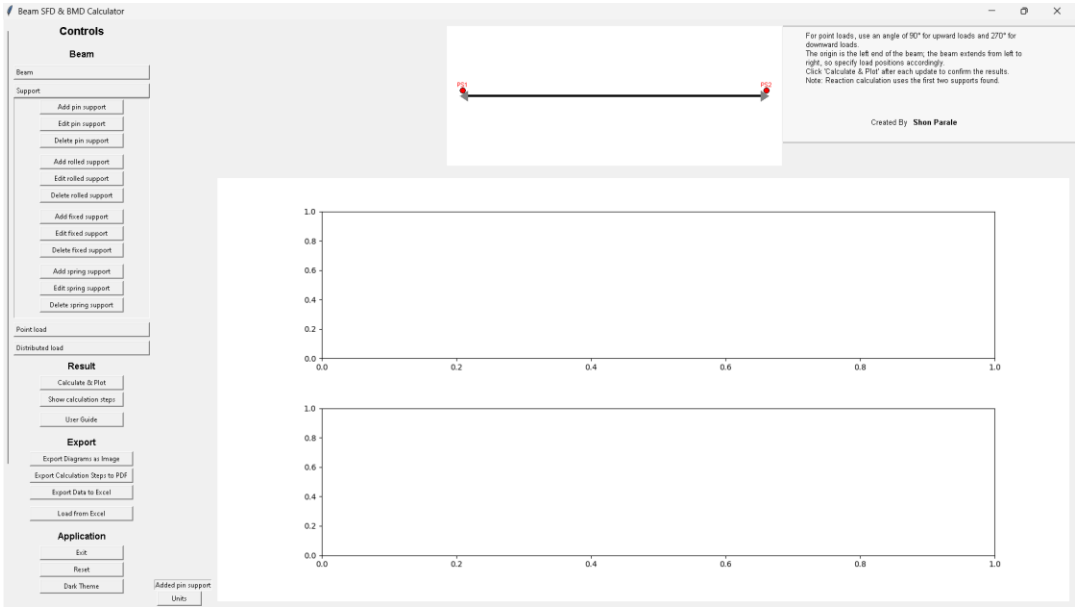
- **Step 1: Model the Beam in App**



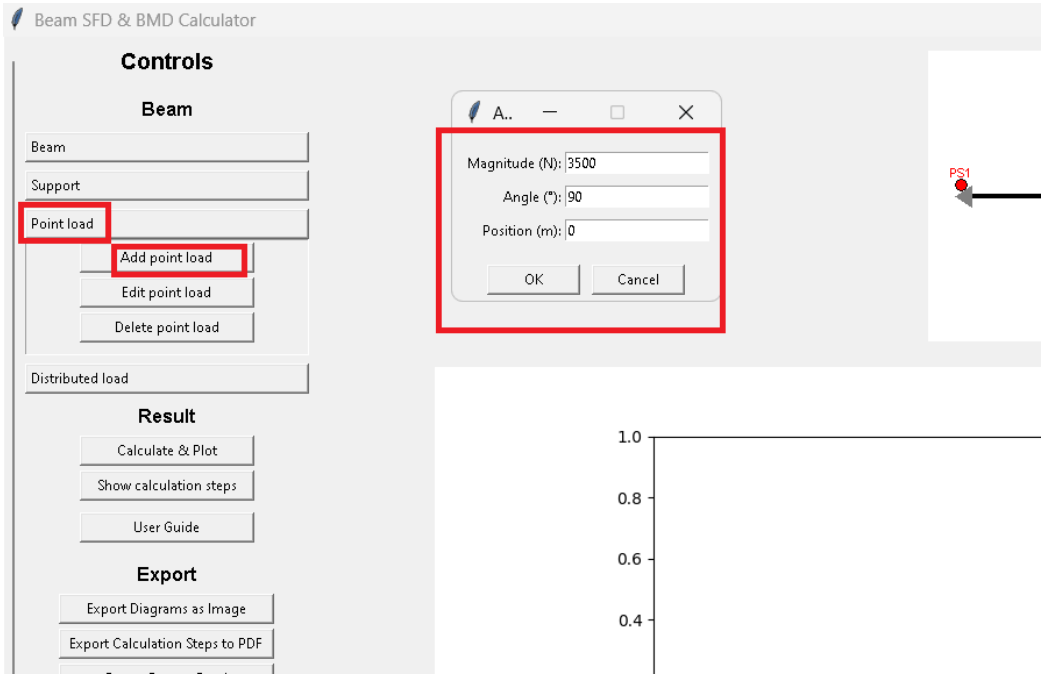
- **Step 2: Add Supports as per Problem Statement**



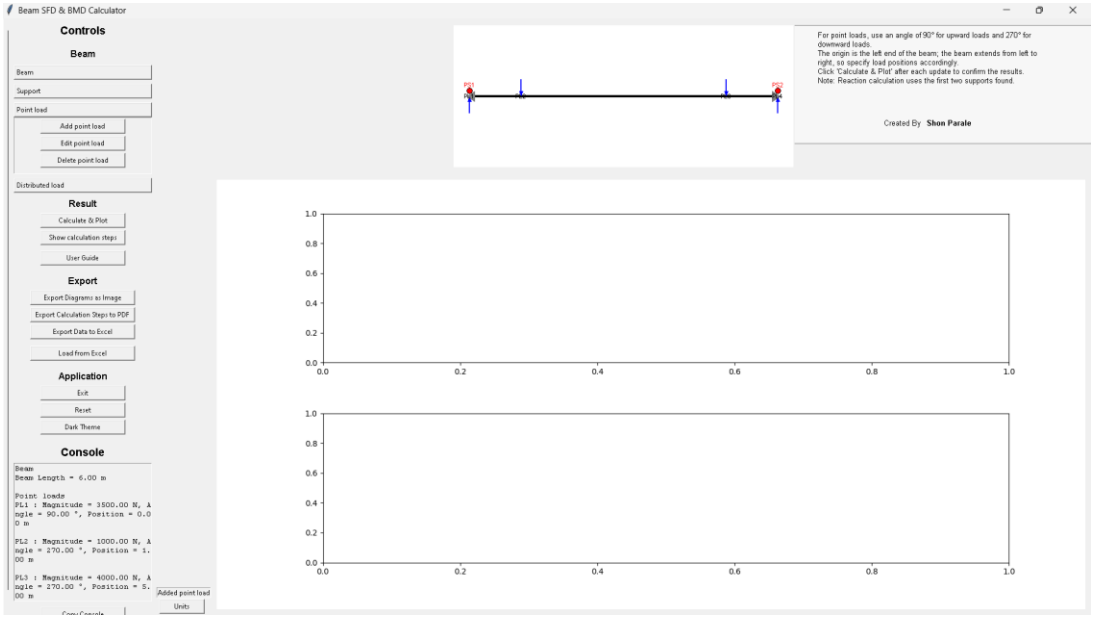




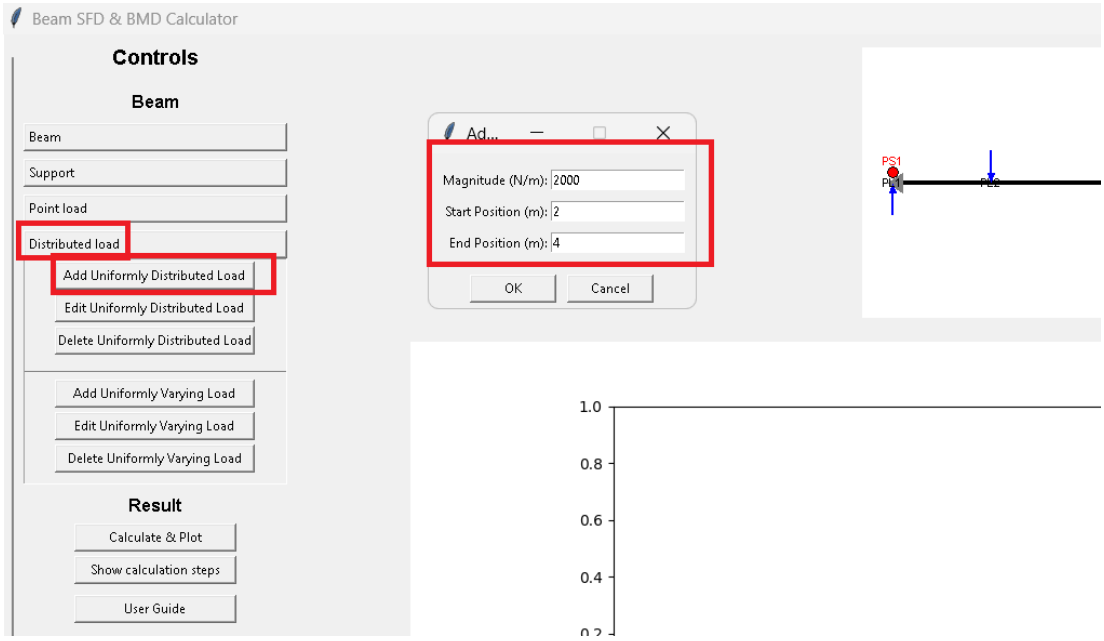
- **Step 3: Apply Loads as per Problem Statement**



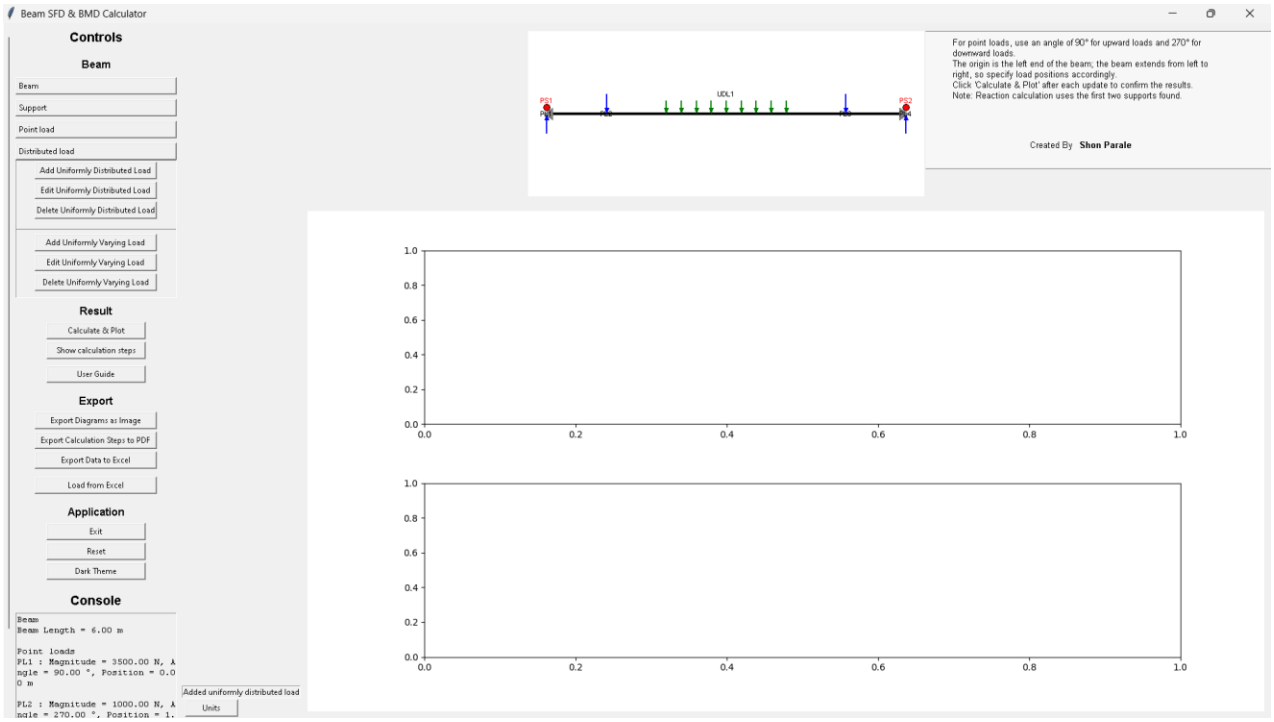
Similarly add all other point loads



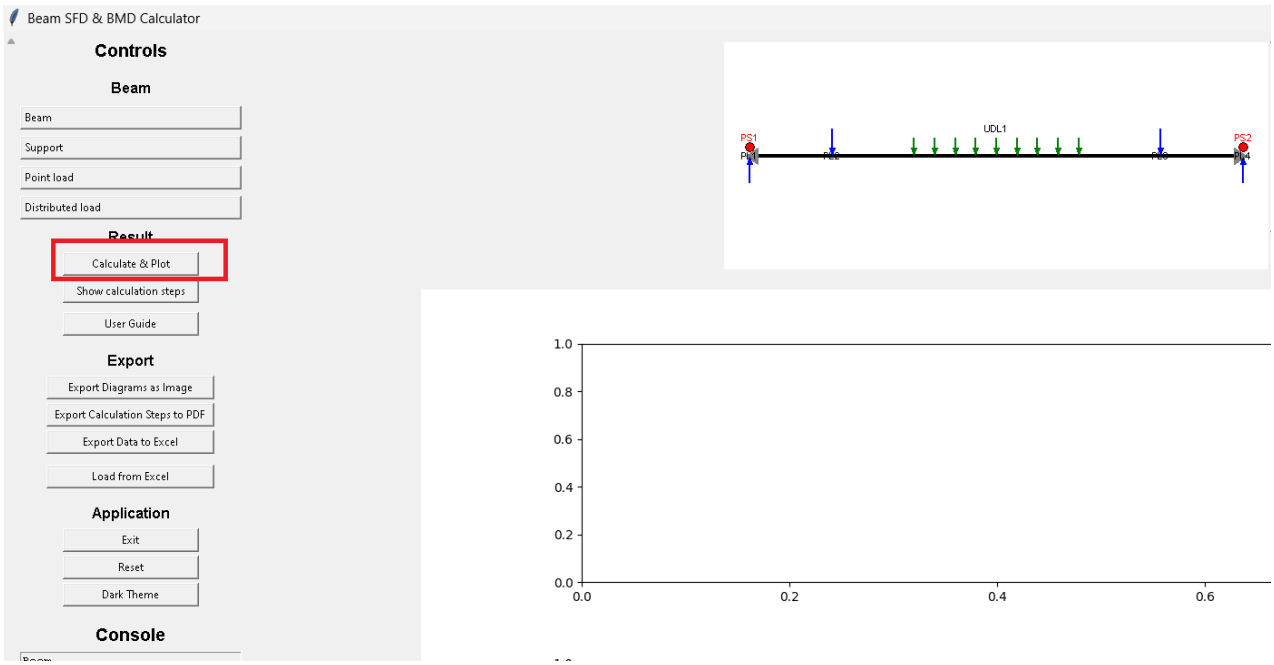
Adding distributed load



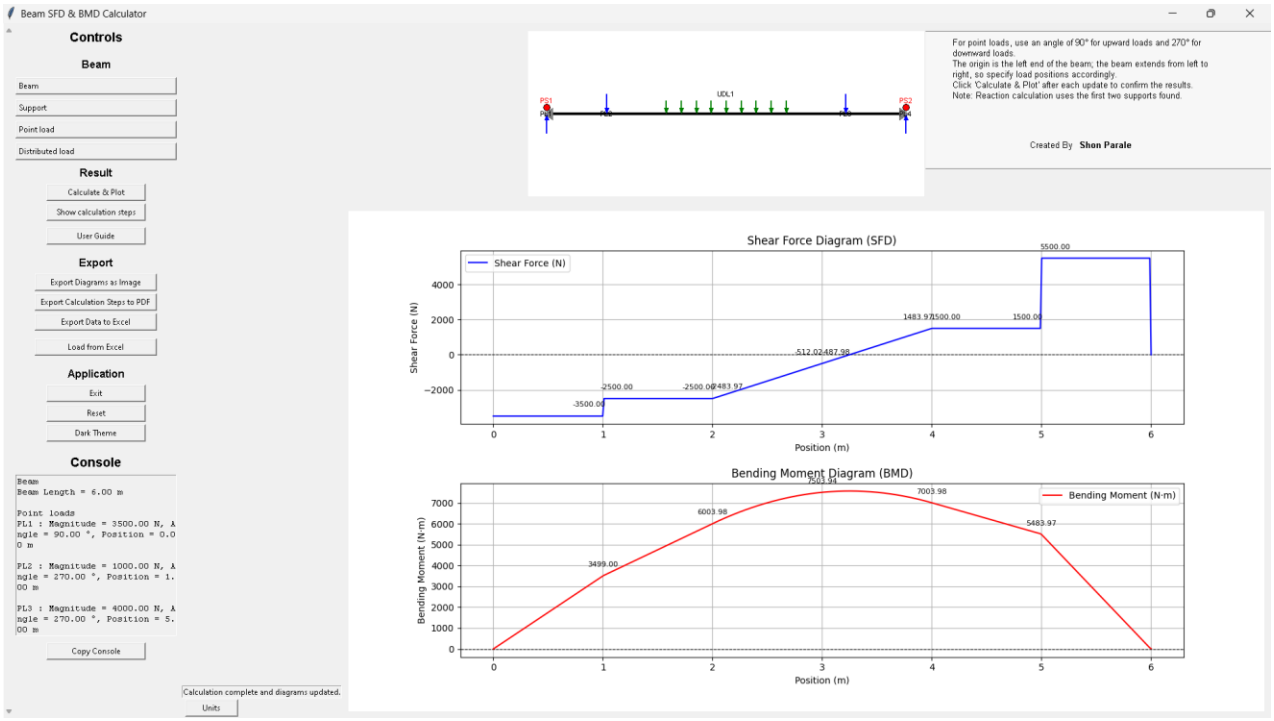
Final with all loads as per question diagram.



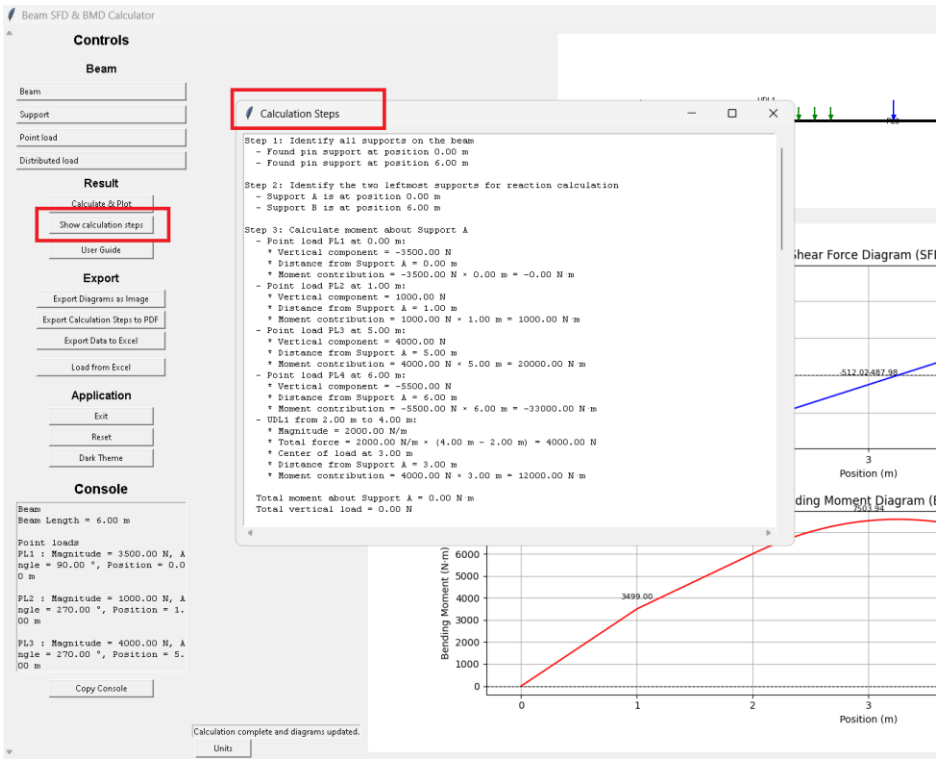
- **Step 4: View Calculated Results**



Calculated SFD & BMD

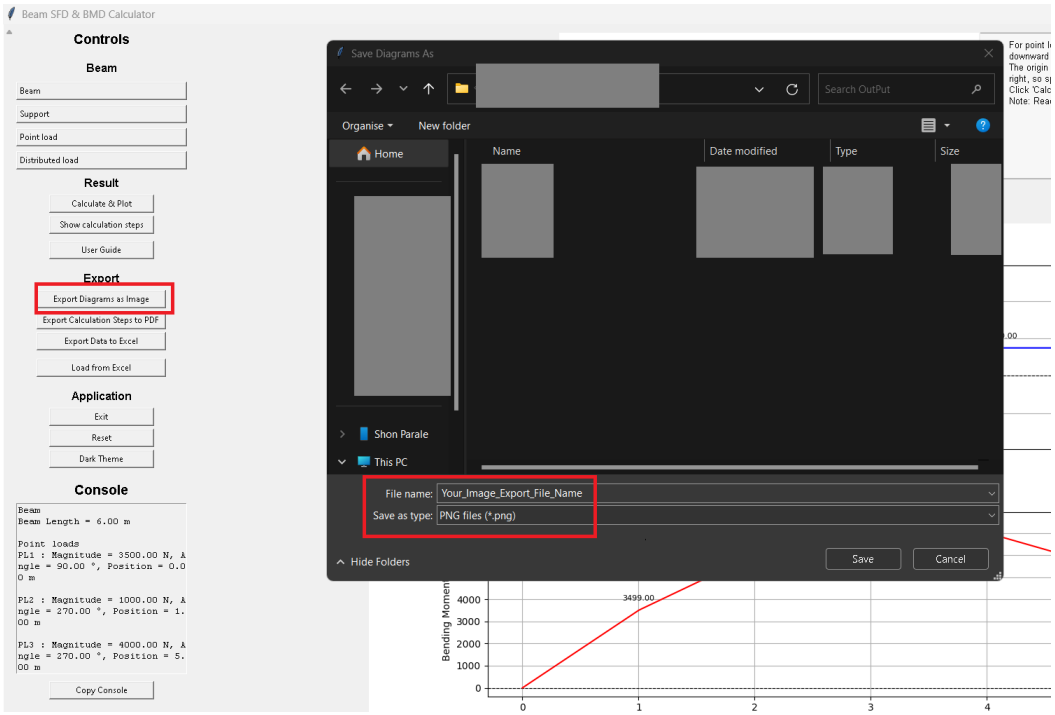


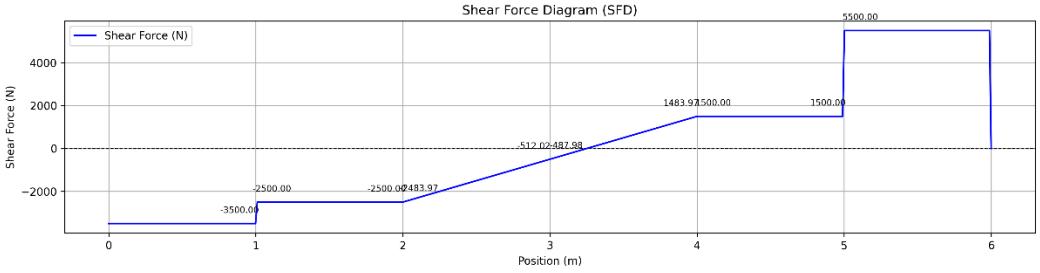
- **Step 5: Show and Review Step-by-Step Calculations**

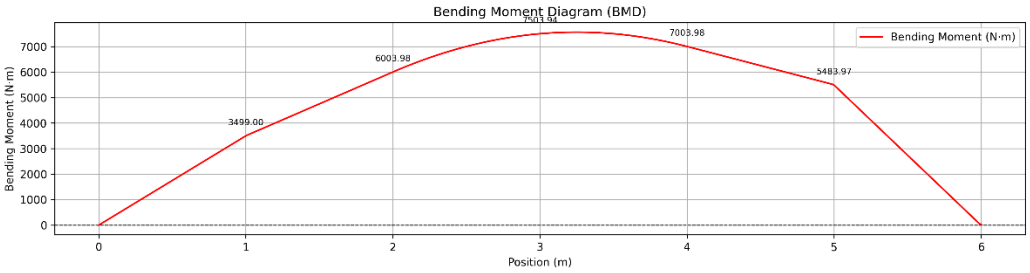


- **Step 6: Export Results for Submission or Reporting**

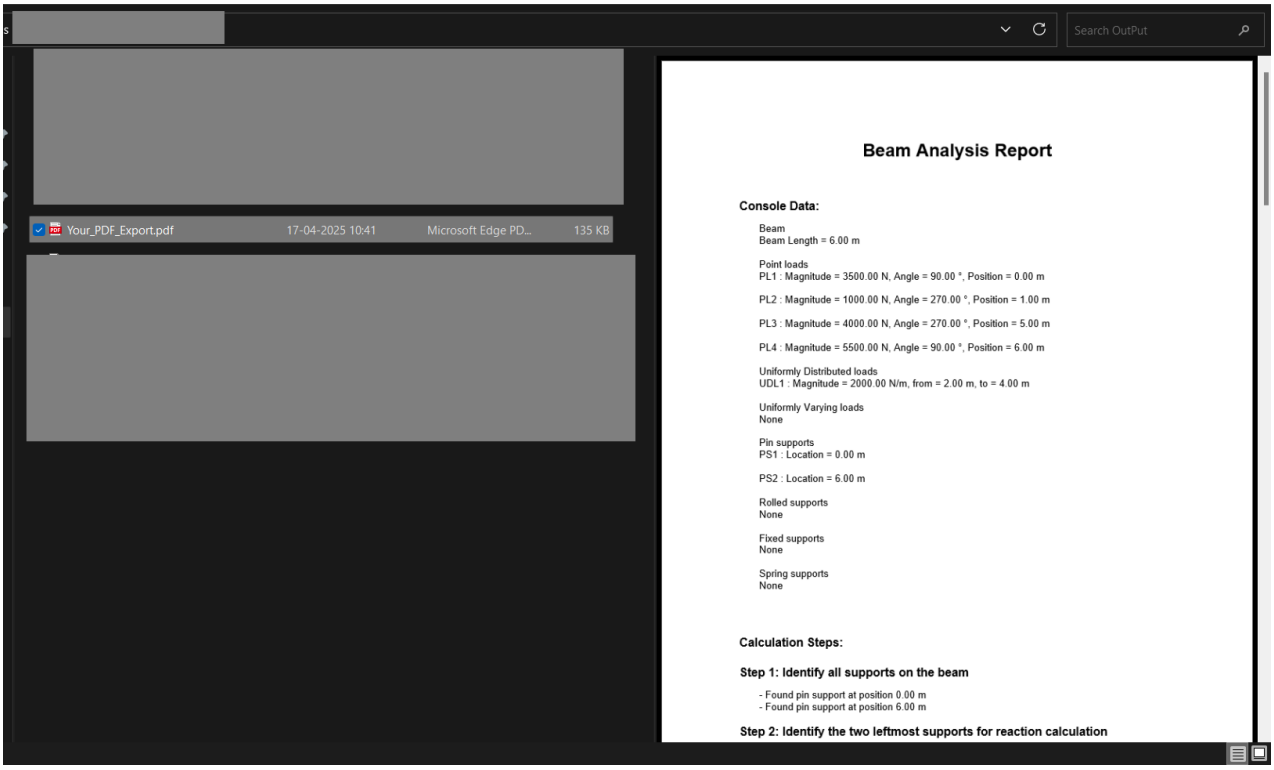
Exporting diagram as image



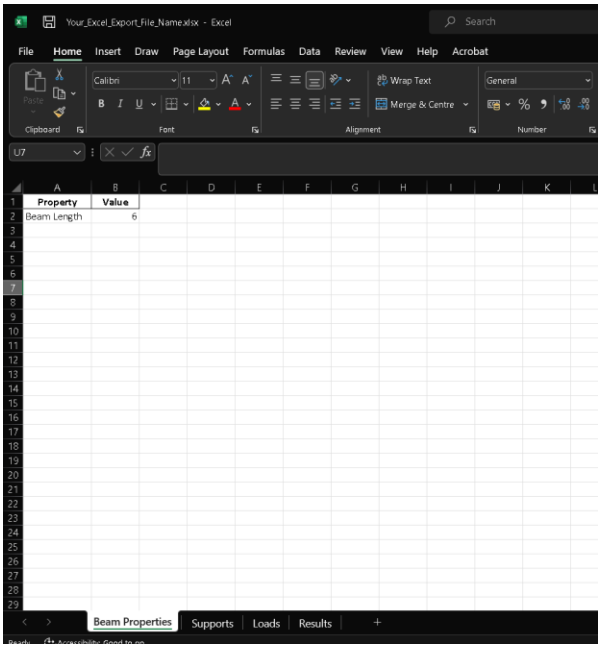


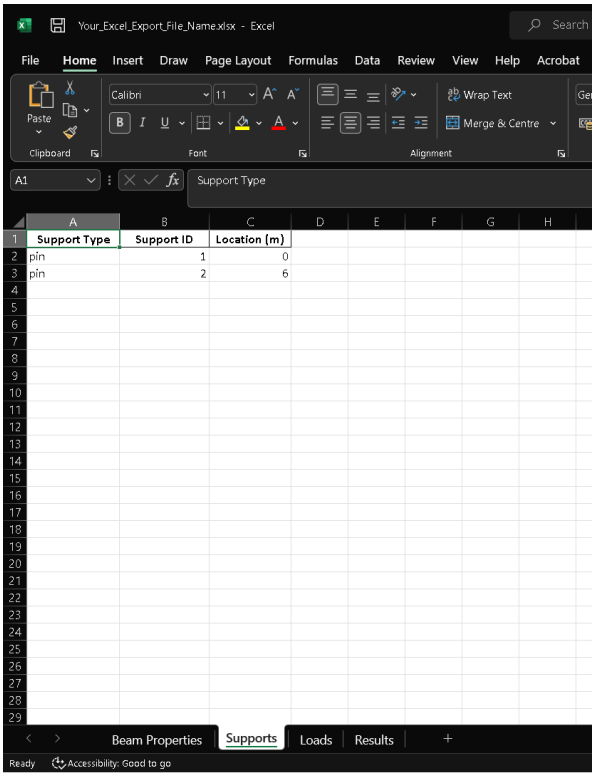


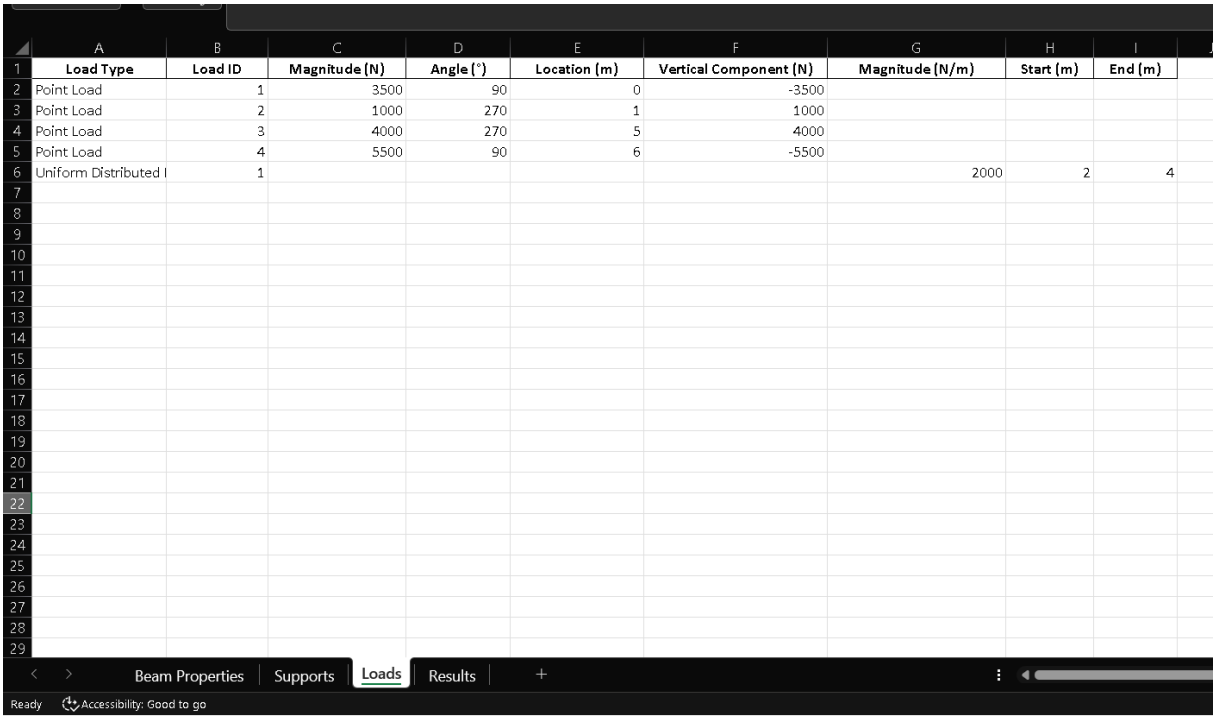
Export steps to pdf



Excel file export







	A	B	C	D	E	F	G	H	I
1	**Load Type**	**Load ID**	**Magnitude (N)**	**Angle (°)**	**Location (m)**	**Vertical Component (N)**	**Magnitude (N/m)**	**Start (m)**	**End (m)**
2	Point Load	1	3500	90	0	-3500			
3	Point Load	2	1000	270	1	1000			
4	Point Load	3	4000	270	5	4000			
5	Point Load	4	5500	90	6	-5500			
6	Uniform Distributed I	1					2000	2	4
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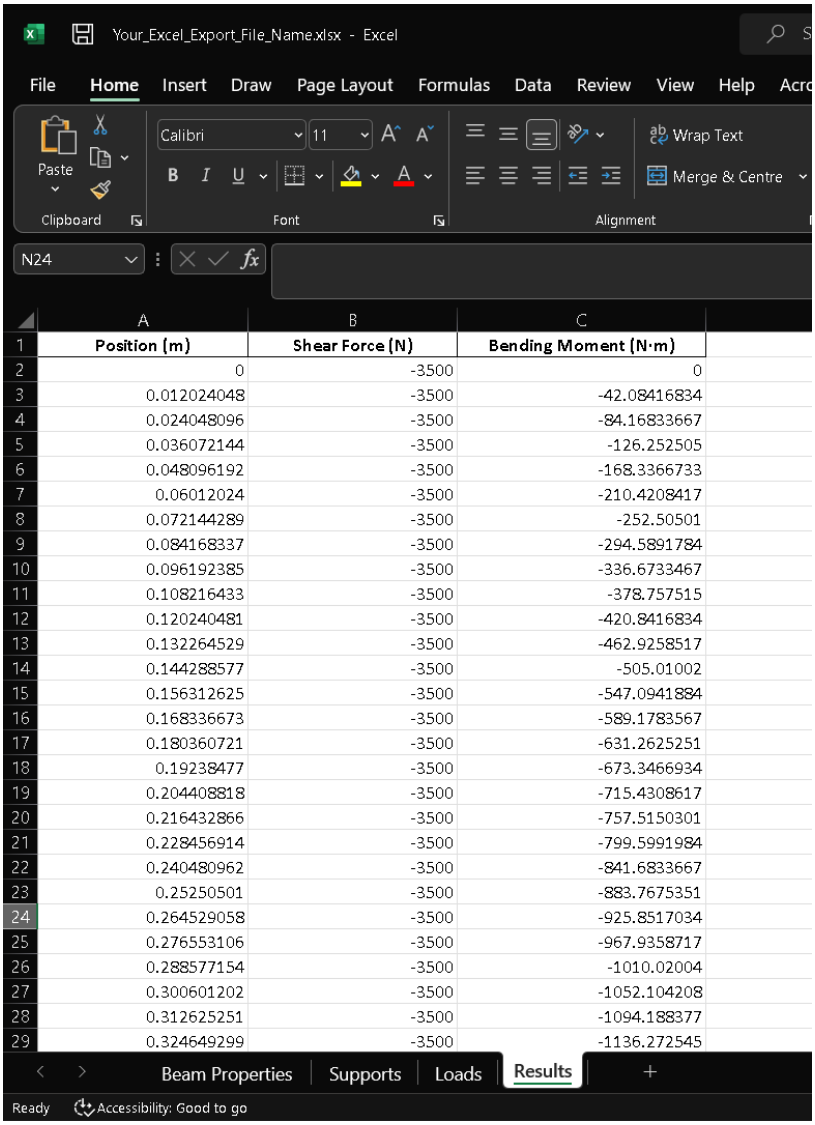
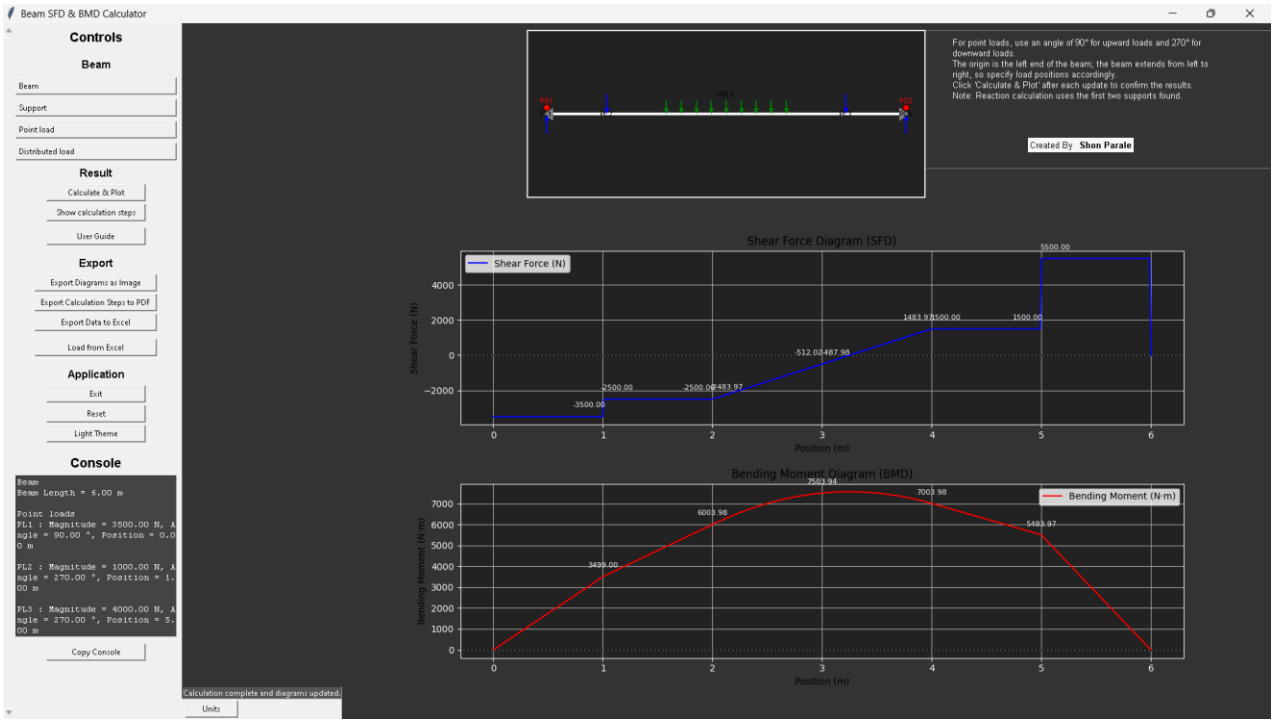


	A	B	C
1	**Position (m)**	**Shear Force (N)**	**Bending Moment (N·m)**
2	0	-3500	0
3	0.012024048	-3500	-42.08416834
4	0.024048096	-3500	-84.16833667
5	0.036072144	-3500	-126.252505
6	0.048096192	-3500	-168.3366733
7	0.06012024	-3500	-210.4208417
8	0.072144289	-3500	-252.50501
9	0.084168337	-3500	-294.5891784
10	0.096192385	-3500	-336.6733467
11	0.108216433	-3500	-378.757515
12	0.120240481	-3500	-420.8416834
13	0.132264529	-3500	-462.9258517
14	0.144288577	-3500	-505.01002
15	0.156312625	-3500	-547.0941884
16	0.168336673	-3500	-589.1783567
17	0.180360721	-3500	-631.2625251
18	0.19238477	-3500	-673.3466934
19	0.204408818	-3500	-715.4308617
20	0.216432866	-3500	-757.5150301
21	0.228456914	-3500	-799.5991984
22	0.240480962	-3500	-841.6833667
23	0.25250501	-3500	-883.7675351
24	0.264529058	-3500	-925.8517034
25	0.276553106	-3500	-967.9358717
26	0.288577154	-3500	-1010.02004
27	0.300601202	-3500	-1052.104208
28	0.312625251	-3500	-1094.188377
29	0.324649299	-3500	-1136.272545

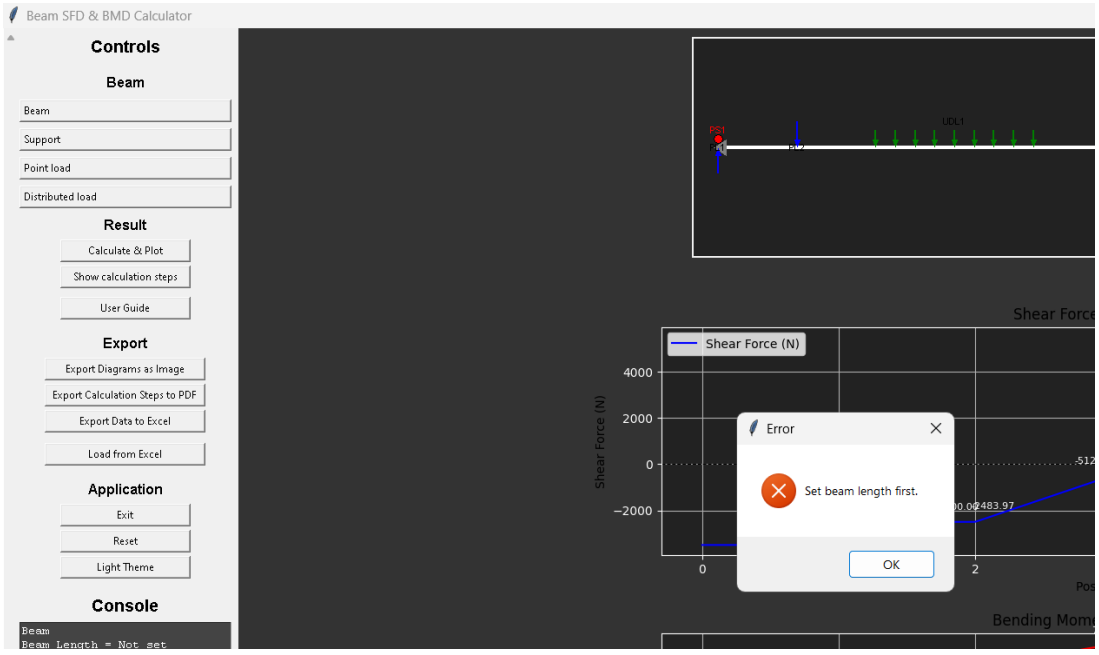
Additional Features

- **Theme Toggle:** Switch between light and dark modes for comfortable viewing.

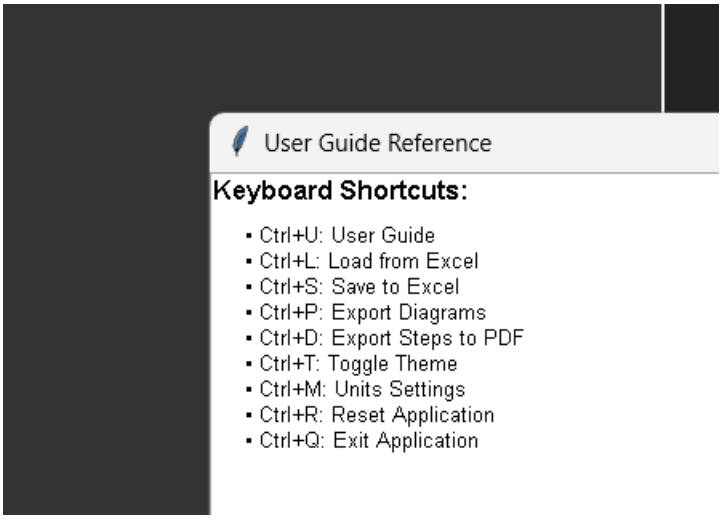


- **Reset:** Quickly clear all inputs to start a new analysis.

- **Error Handling:** The app provides clear messages and guidance if invalid input is detected.



- **Accessibility:** All features are accessible via both mouse and keyboard shortcuts.



USER GUIDE

Keyboard Shortcuts:

• Ctrl+U: User Guide

• Ctrl+L: Load from Excel

• Ctrl+S: Save to Excel

• Ctrl+P: Export Diagrams

• Ctrl+D: Export Steps to PDF

• Ctrl+T: Toggle Theme

• Ctrl+M: Units Settings

• Ctrl+R: Reset Application

• Ctrl+Q: Exit Application

Beam Configurations:

• New Beam: Custom beam with user-defined length and supports

• Simply Supported: Two supports (pin + roller) at both ends

• Cantilever: Fixed support at left end only

• Fixed-Fixed: Fixed supports at both ends

• Overhanging: Supports placed between beam ends

• Propped Cantilever: Fixed + roller support configuration

Support Definitions:

• Pin (PS): Allows rotation, resists vertical/horizontal forces

• Roller (RS): Allows horizontal movement and rotation

• Fixed (FS): Restricts all movement and rotation

• Spring (SS): Provides elastic support with stiffness

Load Types:

• Point Load: Concentrated force at specific location

• UDL: Uniformly Distributed Load - constant intensity

• VDL: Varying Distributed Load - linear intensity change

Interface Legend:

• PS: Pin Support

• RS: Roller Support

• FS: Fixed Support

• SS: Spring Support

• PL: Point Load

• UDL: Uniform Distributed Load

• VDL: Varying Distributed Load

Available Units:

• Length: meter, cm, mm, inch, foot, yard, mile

• Force: newton, kN, MN, lbf, kip

• Moment: N·m, N·mm, kN·m, lb·ft, kip·ft

• Angle: degree, radian, gradian

Who Can Use This App?

- Civil and mechanical engineering students
- Structural engineers and designers
- Architects
- Educators and trainers
- Anyone needing quick, accurate beam analysis and documentation

This app streamlines the process of beam analysis, making it accessible and efficient for users of all experience levels. For detailed instructions on any feature, open the in-app User Guide (Ctrl + U).

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