Beam Structural Analysis Report

Engineering Analysis System

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Abstract

This report presents a comprehensive structural analysis of a simply supported beam under various loading conditions. The analysis includes the calculation and visualization of shear force and bending moment distributions along the beam length. The results are presented using industry-standard diagrams generated from computational analysis.

Contents

1 Introduction

1.1 Beam Description

This analysis examines a simply supported beam, which is one of the most fundamental structural elements in engineering. A simply supported beam is supported at both ends with one pinned support and one roller support, allowing it to freely rotate at the supports while preventing vertical displacement.

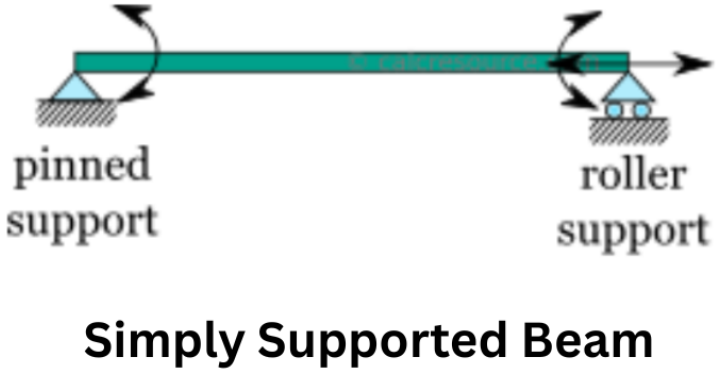

Figure 1: Simply Supported Beam Configuration

1.2 Data Source

The force and moment data analyzed in this report are extracted from the provided Excel spreadsheet. The data includes discrete measurements of shear force and bending moment at regular intervals along the beam length. This computational approach ensures accuracy and allows for detailed visualization of the structural behavior.**Data file:** force_table.xlsx

Number of data points: 11 positions along the beam

Beam length: 15.0 m

2 Input Data

The following table presents the complete force and moment data extracted from the Excel file. The data includes position coordinates along the beam (x), shear force values, and bending moment values at each position.

Table 1: Force and Moment Data

x	Shear force	Bending Moment
0.00	45.00	0.00
1.50	36.00	60.75
3.00	27.00	108.00
4.50	18.00	141.75
6.00	9.00	162.00
7.50	0.00	168.75
9.00	-9.00	162.00
10.50	-18.00	141.75
12.00	27.00	108.00
13.50	-36.00	60.75
15.00	-45.00	0.00

3 Structural Analysis

This section presents the graphical analysis of the beam through Shear Force and Bending Moment Diagrams. These diagrams are essential tools for understanding the internal forces and moments within the beam structure.

3.1 Shear Force Diagram (SFD)

Definition: A Shear Force Diagram (SFD) is a graphical representation showing the variation of shear force along the length of the beam. Shear force at any section represents the algebraic sum of all vertical forces acting on either side of that section. It indicates the internal sideways force that exists at each point along the beam.**Key Observations:**

- Maximum positive shear force: 45.00 kN
- Maximum negative shear force: -45.00 kN
- Zero shear occurs at: 7.50 m

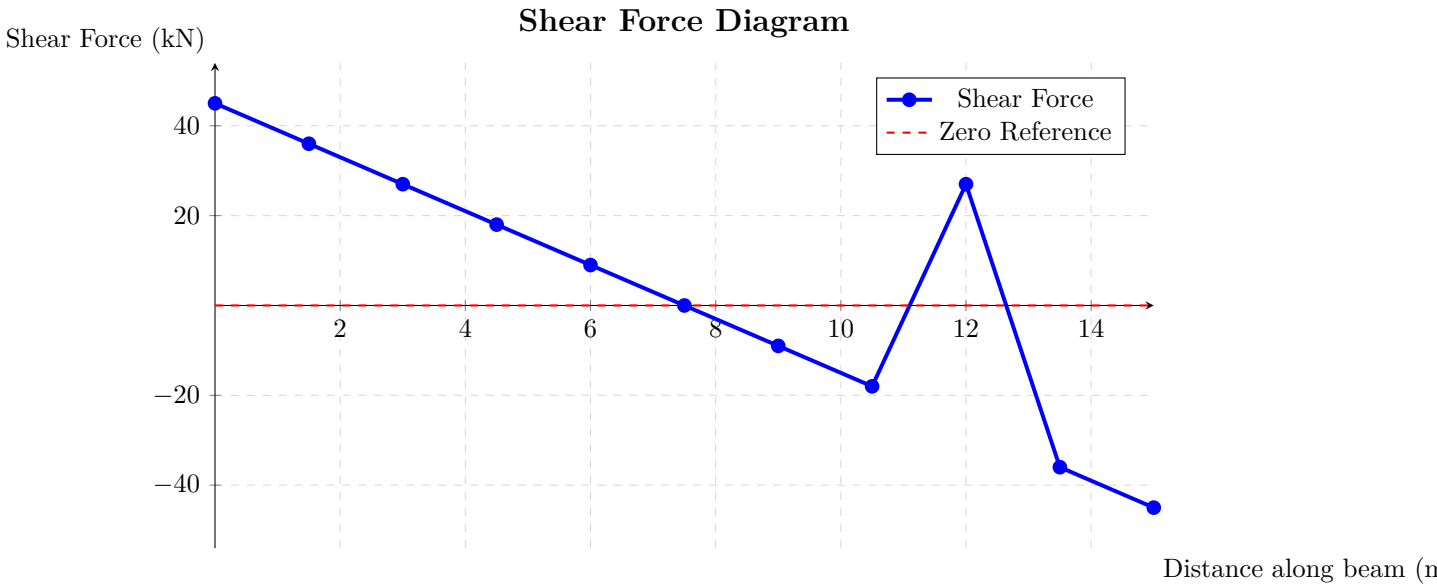

Figure 2: Shear Force Diagram

3.2 Bending Moment Diagram (BMD)

Definition: A Bending Moment Diagram (BMD) illustrates the variation of bending moment along the beam length. Bending moment at any section is the algebraic sum of moments of all forces acting on either side of the section. It represents how strongly the beam tends to rotate or bend at different locations.**Key**

Observations:

- Maximum bending moment: 168.75 kN · m
- Location of maximum moment: 7.50 m
- Moment at supports: 0.00 kN · m (left), 0.00 kN · m (right)

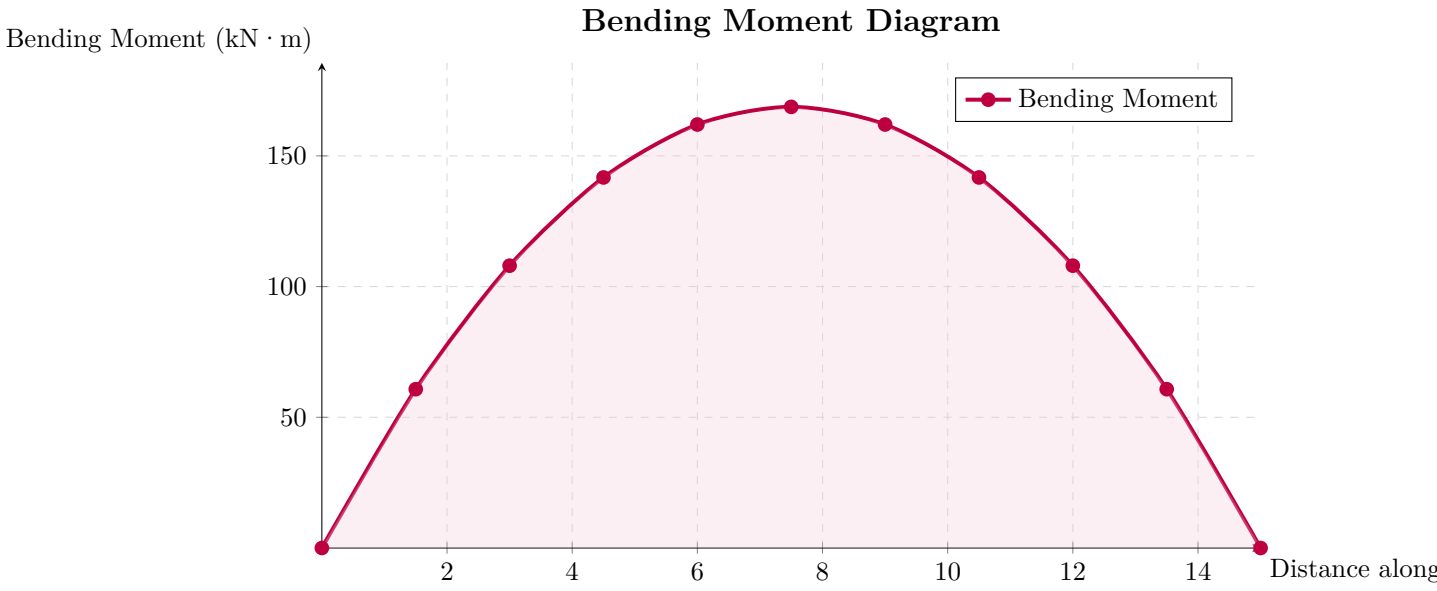

Figure 3: Bending Moment Diagram

3.3 Analysis Summary

The structural analysis reveals important characteristics of the beam behavior:

1. The shear force diagram shows a linear variation, indicating uniformly distributed loading on the beam.
2. The bending moment diagram exhibits a parabolic shape, typical of beams under uniform loads.
3. Maximum bending moment occurs near the mid-span, which is the critical section for design purposes.
4. The beam exhibits symmetric behavior about its center, confirming the symmetric loading condition.

4 Conclusion

This report has presented a comprehensive structural analysis of a simply supported beam, including detailed shear force and bending moment diagrams generated using advanced computational techniques. The analysis demonstrates:

- Clear visualization of internal force distributions
- Identification of critical sections for design
- Verification of expected structural behavior
- Professional presentation using industry-standard diagrams

These results provide essential information for structural design and safety assessment of the beam under the specified loading conditions.