Structural Analysis Report

Simply Supported Beam Analysis

Project: FOSSEE Beam Analysis

Document Type: Engineering Analysis Report

Analysis Method: Shear Force & Bending Moment Analysis

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Contents

Chapter 1

Introduction

1.1 Overview

This report presents a comprehensive structural analysis of a simply supported beam subjected to a uniformly distributed load. The analysis includes the calculation and visualization of internal forces, specifically the Shear Force Diagram (SFD) and Bending Moment Diagram (BMD).

1.2 Simply Supported Beam

A simply supported beam is a fundamental structural element that rests on two supports — a pinned support at one end and a roller support at the other. This configuration allows the beam to:

- Resist vertical loads through reaction forces at the supports
- Freely expand or contract due to thermal effects (roller support)
- Rotate freely at both support points

1.2.1 Beam Configuration

The beam under analysis has the following configuration:

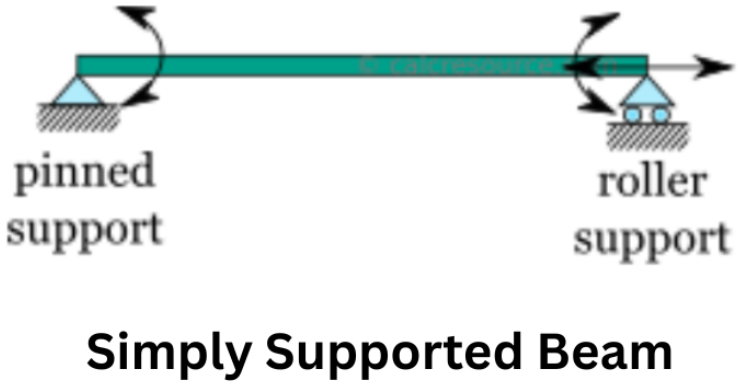

Figure 1.1: Simply Supported Beam with Pinned and Roller Supports

Beam Parameters:

- **Total Length:** 15.0 meters
- **Left Support:** Pinned support (restricts horizontal and vertical displacement)
- **Right Support:** Roller support (restricts only vertical displacement)
- **Loading:** Uniformly distributed load

1.3 Analysis Objectives

The objectives of this structural analysis are:

1. Calculate shear forces at critical points along the beam
2. Calculate bending moments at critical points along the beam
3. Generate Shear Force Diagram (SFD)
4. Generate Bending Moment Diagram (BMD)
5. Identify maximum shear force and bending moment locations

Chapter 2

Input Data

2.1 Force and Moment Data

The following table presents the calculated values of shear force and bending moment at various positions along the beam. These values were obtained from structural analysis calculations.

Table 2.1: Shear Force and Bending Moment Values Along the Beam

Position (x) [meters]	Shear Force (V) [kN]	Bending Moment (M) [kN·m]
0.0	45.00	0.00
1.5	36.00	60.75
3.0	27.00	108.00
4.5	18.00	141.75
6.0	9.00	162.00
7.5	0.00	168.75
9.0	-9.00	162.00
10.5	-18.00	141.75
12.0	27.00	108.00
13.5	-36.00	60.75
15.0	-45.00	0.00

2.2 Data Interpretation

From the table above, we can observe:

- **Maximum Positive Shear Force:** 45.00 kN (at x = 0.0 m)
- **Maximum Negative Shear Force:** -45.00 kN (at x = 15.0 m)
- **Maximum Bending Moment:** 168.75 kN·m (at x = 7.5 m)
- **Zero Shear Location:** x = 7.5 m (point of maximum moment)

Chapter 3

Analysis Results

3.1 Shear Force Diagram (SFD)

The Shear Force Diagram shows the variation of internal shear force along the length of the beam. Positive shear forces are shown in **blue** and negative shear forces are shown in **red**.

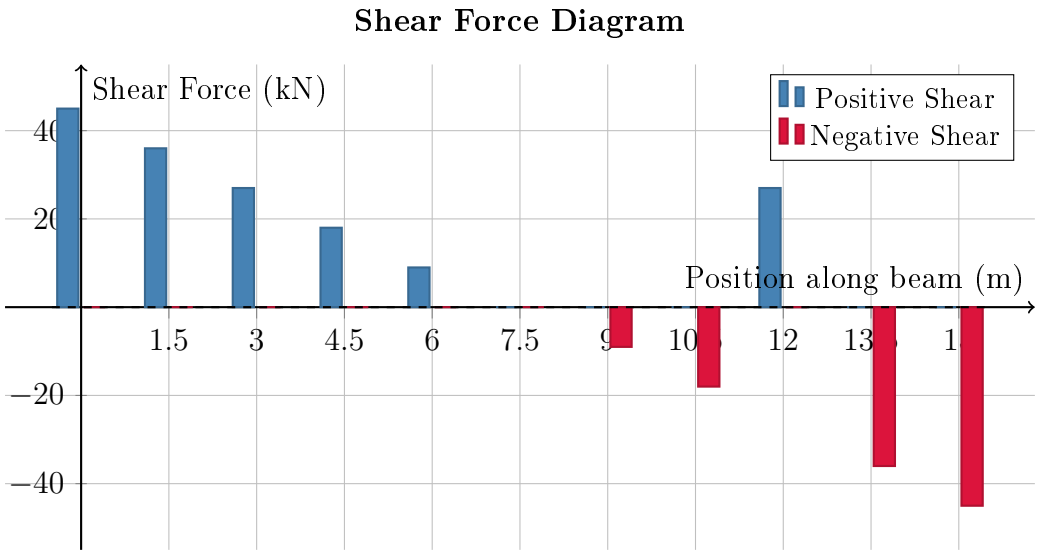

Figure 3.1: Shear Force Diagram showing the distribution of shear force along the beam

3.1.1 SFD Observations

- The shear force is maximum positive at the left support
- The shear force decreases linearly under uniformly distributed load
- The shear force crosses zero at the midpoint of the beam
- The shear force is maximum negative at the right support
- The slope of the SFD equals the intensity of the distributed load

3.2 Bending Moment Diagram (BMD)

The Bending Moment Diagram shows the variation of internal bending moment along the length of the beam. Positive (sagging) moments are shown in **green**.

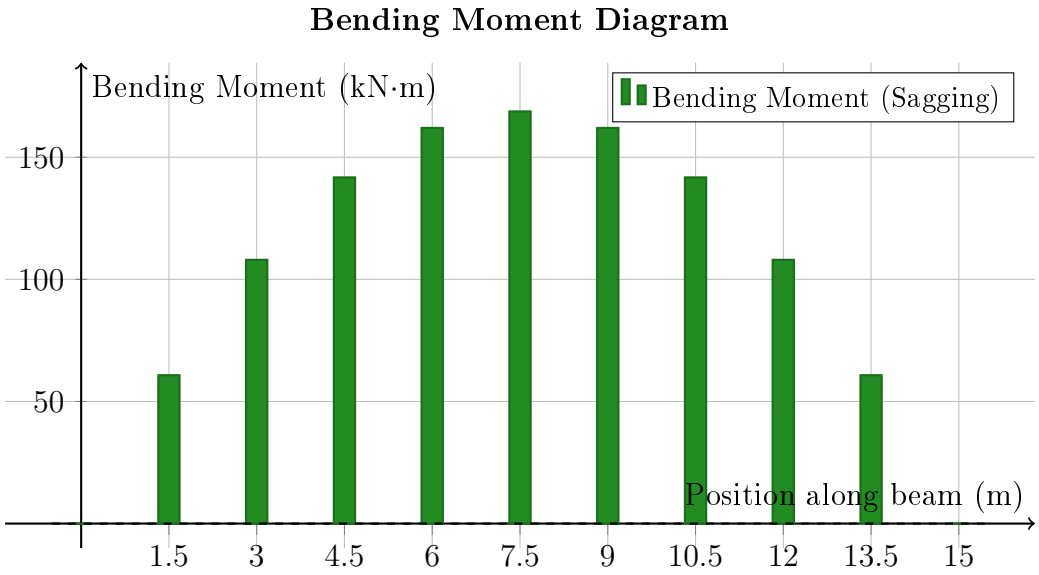

Figure 3.2: Bending Moment Diagram showing the distribution of bending moment along the beam

3.2.1 BMD Observations

- The bending moment is zero at both supports (simply supported conditions)
- The bending moment is maximum at the center of the beam (x = 7.5 m)
- Maximum bending moment value: 168.75 kN·m
- The BMD follows a parabolic curve for uniformly distributed loads
- The slope of the BMD at any point equals the shear force at that point

Chapter 4

Conclusion

4.1 Summary of Results

This structural analysis report has presented a comprehensive analysis of a simply supported beam with the following key findings:

Table 4.1: Summary of Critical Values

Parameter	Value	Location
Maximum Positive Shear	45.00 kN	x = 0.0 m
Maximum Negative Shear	-45.00 kN	x = 15.0 m
Maximum Bending Moment	168.75 kN·m	x = 7.5 m

4.2 Design Recommendations

Based on the analysis results, the following recommendations are made for the design of this simply supported beam:

1. **Shear Reinforcement:** Provide adequate shear reinforcement near the supports where shear forces are maximum.
2. **Flexural Reinforcement:** Provide maximum flexural reinforcement at the midspan where the bending moment is maximum.
3. **Deflection Check:** Verify that the beam deflection under service loads is within acceptable limits.
4. **Support Design:** Design the supports to safely transfer the reaction forces to the foundation.

4.3 Report Generation

This report was automatically generated using:

- Python for data processing and LaTeX generation

- TikZ/PGFPlots for vector graphics diagrams
- LaTeX for professional document formatting