Simply Supported Beam: Moment, Deflection, Stress

Reactions, maximum bending moment, mid-span deflection and bending stress of a simply supported beam under a uniform load and a central point load.

Method: Euler–Bernoulli beam theory

Input parameters

Unit system: SI

Parameter	Value	Unit
Span	6.0000	m
Uniformly distributed load (including self weight)	10.000	kN/m
Point load at mid-span	20.000	kN
Modulus of elasticity	200.00	GPa
Second moment of area	8,603.0	cm^4
Elastic section modulus	573.60	cm^3

Calculated results

Parameter	Value	Unit
Maximum bending moment (mid-span)	75.000	kN·m
Mid-span deflection	15.038	mm
Maximum bending stress	130.75	MPa
Each support reaction	40.000	kN
Span over deflection	398.98	

Notes for this case

- Elastic small-deflection theory; check shear, lateral-torsional buckling and local bearing separately to your design code.

Formula and method

$$R = \frac{wL + P}{2} \qquad M_{max} = \frac{wL^2}{8} + \frac{PL}{4} \qquad \delta_{max} = \frac{5wL^4}{384EI} + \frac{PL^3}{48EI} \qquad \sigma_b = \frac{M_{max}}{Z}$$

Variables

L	span	m
w	distributed load	N/m
P	central point load	N
E	modulus of elasticity	Pa
I	second moment of area	m^4
Z	section modulus	m^3
M_{max}	maximum moment	N·m
δ_{max}	mid-span deflection	m
σ_b	bending stress	Pa
R	each reaction	N
L/δ	span over deflection	–

Method and standards

Euler–Bernoulli small-deflection theory, superposing the uniform and central point load cases.

Assumptions and limits

- Linear elastic, small deflection; shear and buckling checked separately.

- The bending stress is not compared with an allowable stress: check it against your design code.

References

- Euler–Bernoulli beam theory

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/strength-of-materials/simply-supported-beam

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.