Propped Cantilever with Uniform Load

Reactions, fixed-end moment, maximum sagging moment and maximum deflection and its position for a propped cantilever under a uniformly distributed load.

Method: Textbook mechanics (Roark's Formulas for Stress and Strain, beam tables)

Input parameters

Unit system: SI

Parameter	Value	Unit
Uniform load	10.000	kN/m
Span	5.0000	m
Young's modulus	200.00	GPa
Second moment of area	836.00	cm^4

Calculated results

Parameter	Value	Unit
Reaction at the prop 3wL/8	18.750	kN
Reaction at the fixed end 5wL/8	31.250	kN
Moment at the fixed end wL²/8	31,250	N·m
Maximum sagging moment 9wL²/128	17,578	N·m
Maximum deflection	20.246	mm
Distance of the maximum deflection from the prop	2.1077	m

Formula and method

$$R_A = \frac{3wL}{8}, \quad M_B = \frac{wL^2}{8}, \quad y(x) = \frac{wx(L^3 - 3Lx^2 + 2x^3)}{48EI}, \quad x_{max} = \frac{1+\sqrt{33}}{16}L$$

Variables

w	Uniform load	N/m
L	Span	m
E	Young's modulus	Pa
I	Second moment of area	m^4
R_A	Reaction at the prop 3wL/8	N
R_B	Reaction at the fixed end 5wL/8	N
M_B	Moment at the fixed end wL²/8	N·m
M_{max}	Maximum sagging moment 9wL²/128	N·m
δ_{max}	Maximum deflection	m
x_{max}	Distance of the maximum deflection from the prop	m

Method and standards

Elastic beam theory.

Assumptions and limits

- Prismatic beam; uniform load over the whole span only.
- No bending stress is computed: divide the larger moment (M_B) by the section modulus.

References

- Textbook mechanics (Roark's Formulas for Stress and Strain, beam tables)

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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/propped-cantilever

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Reopens the calculator with the inputs of this report.