Overhanging Beam: Reactions, Moments and Tip Deflection

Reactions, hogging moment at the support, maximum sagging moment and tip deflection of a beam on two supports with one overhang, under a uniform load and a tip load.

Method: Equilibrium and double integration of the elastic curve (Timoshenko and Young, Theory of Structures, 2nd ed. (McGraw-Hill); Roark's Formulas for Stress and Strain, table 8.1)

Input parameters

Unit system: SI

Parameter	Value	Unit
Span between supports	6.0000	m
Overhang length	2.0000	m
Uniform load (whole length)	10.000	kN/m
Point load at the tip	5.0000	kN
Elastic modulus	200.00	GPa
Second moment of area	8,000.0	cm^4

Calculated results

Parameter	Value	Unit
Reaction at the far support	25.000	kN
Reaction at the overhang support	60.000	kN
Hogging moment at the overhang support	30.000	kN·m
Maximum sagging moment in the span	31.250	kN·m
Tip deflection (downward)	-1.6667	mm

Notes for this case

- Linear elastic, constant EI. Negative tip deflection means the tip rises (span load lifts it). The largest deflection within the span is not computed.

Formula and method

$$R_B = \frac{w(L+a)^2/2 + P(L+a)}{L}, \quad \delta_{tip} = \frac{Pa^2(L+a)}{3EI} + \frac{wa(4a^2L + 3a^3 - L^3)}{24EI}$$

Variables

L	Span between supports	m
a	Overhang length	m
w	Uniform load (whole length)	N/m
P	Point load at the tip	N
E	Elastic modulus	Pa
I	Second moment of area	m^4
R_A	Reaction at the far support	N
R_B	Reaction at the overhang support	N
M_B	Hogging moment at the overhang support	N·m
M^+	Maximum sagging moment in the span	N·m
δ_{tip}	Tip deflection (downward)	m

Method and standards

Equilibrium and elastic curve.

Assumptions and limits

- Constant EI; small deflections.
- Only the tip deflection is computed; the deflection within the span is not.
- A negative R_A means uplift at A (a warning is given).

References

• Equilibrium and double integration of the elastic curve (Timoshenko and Young, Theory of Structures, 2nd ed. (McGraw-Hill); Roark's Formulas for Stress and Strain, table 8.1)

Report details

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Release checks	2 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

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