Section Properties: Area, Moment of Inertia, Section Modulus

Area, second moment of area, section modulus and radius of gyration of rectangular, hollow rectangular, round, tube and I-sections about both axes.

Method: Second moments of area of standard shapes (Roark's Formulas for Stress and Strain, Table A.1)

Input parameters

Unit system: SI

Parameter	Value	Unit
Section	Solid rectangle (b × h)	
Width, flange width or outside diameter	200.00	mm
Depth (rectangles and I-section)	400.00	mm
Wall thickness, or flange thickness of the I-section	12.000	mm
Web thickness (I-section)	8.0000	mm

Calculated results

Parameter	Value	Unit
Area	800.00	cm^2
Second moment of area about the x axis (strong, horizontal)	106,667	cm^4
Elastic section modulus about x	5,333.3	cm^3
Radius of gyration about x	115.47	mm
Second moment of area about the y axis	26,667	cm^4
Elastic section modulus about y	2,666.7	cm^3
Radius of gyration about y	57.735	mm

Notes for this case

- Sharp corners: root radii of rolled sections add a little area and stiffness; use the maker's tables for rolled sections.

Formula and method

$$I_x = \frac{bh^3}{12}, \quad I_x = \frac{bh^3 - (b - t_w)(h - 2t)^3}{12}\ \text{(I)}, \quad I = \frac{\pi D^4}{64}\ \text{(round)}$$

$$Z = \frac{I}{c}, \quad r = \sqrt{I/A}$$

Variables

shape	Section	-
b	Width, flange width or outside diameter	m
h	Depth (rectangles and I-section)	m
t	Wall thickness, or flange thickness of the I-section	m
t_w	Web thickness (I-section)	m
A	Area	m^2
I_x	Second moment of area about the x axis (strong, horizontal)	m^4
Z_x	Elastic section modulus about x	m^3
r_x	Radius of gyration about x	m
I_y	Second moment of area about the y axis	m^4
Z_y	Elastic section modulus about y	m^3

r_y	Radius of gyration about y	m
c	Distance from the axis to the extreme fibre	m

Method and standards

Second moments of area of standard shapes about their centroidal axes; the elastic section modulus divides by the distance to the extreme fibre.

Assumptions and limits

- Sharp-cornered, doubly symmetric shapes.

References

- Second moments of area of standard shapes (Roark's Formulas for Stress and Strain, Table A.1)

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/section-properties

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.