Built-Up I-Section with Unequal Flanges: Elastic and Plastic Moduli

Area, centroid, second moments of area, elastic section moduli to each flange, plastic section modulus and radius of gyration of a welded monosymmetric I-section.

Method: Elastic and plastic properties of plate sections

Input parameters

Unit system: SI

Parameter	Value	Unit
Top flange width	300.00	mm
Top flange thickness	20.000	mm
Web depth (clear)	800.00	mm
Web thickness	10.000	mm
Bottom flange width	250.00	mm
Bottom flange thickness	16.000	mm

Calculated results

Parameter	Value	Unit
Area	18,000	mm^2
Centroid above bottom	462.00	mm
Second moment of area, major axis	206,332	cm^4
Elastic modulus to top fibre	5,516.9	cm^3
Elastic modulus to bottom fibre	4,466.1	cm^3
Plastic section modulus	5,592.0	cm^3
Second moment of area, minor axis	6,590.0	cm^4
Minor-axis radius of gyration	60.507	mm

Notes for this case

• Parallel-axis theorem for the three plates; the plastic neutral axis splits the area in half, Z_p = Σ|A_iy_i| about it. Fillet welds are ignored. Unequal flanges suit crane girders (wider top flange for lateral loads) and composite beams (smaller top flange).

Formula and method

$$\bar{y} = \frac{\sum A_i y_i}{\sum A_i}, \quad I_x = \sum \left(I_i + A_i (y_i - \bar{y})^2 \right), \quad Z_p = \sum \left| A_i (y_i - y_p) \right|$$

Variables

b_1	Top flange width	m
t_1	Top flange thickness	m
h_w	Web depth (clear)	m
t_w	Web thickness	m
b_2	Bottom flange width	m
t_2	Bottom flange thickness	m
A	Area	m^2
$\bar{y}$	Centroid above bottom	m

I_x	Second moment of area, major axis	m⁴
Z_{top}	Elastic modulus to top fibre	m³
Z_{bot}	Elastic modulus to bottom fibre	m³
Z_p	Plastic section modulus	m³
I_y	Second moment of area, minor axis	m⁴
r_y	Minor-axis radius of gyration	m

Method and standards

Built-up section.

Assumptions and limits

- Plates only; welds and corner radii ignored.

References

Elastic and plastic properties of plate sections

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/civil/steel/unequal-flange-i-section

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.