Torsion of Thin-Walled Closed Tubes (Bredt)

Shear stress and angle of twist of a thin-walled closed rectangular tube under torque by Bredt's formulas, from the mean dimensions and wall thickness.

Method: Bredt–Batho thin-walled tube theory (Timoshenko, Strength of Materials)

Input parameters

Unit system: SI

Parameter	Value	Unit
Torque	2,000.0	N·m
Mean width (centre line of the wall)	100.00	mm
Mean height	60.000	mm
Wall thickness	4.0000	mm
Length	2.0000	m
Shear modulus	79.000	GPa

Calculated results

Parameter	Value	Unit
Area enclosed by the wall centre line	6,000.0	mm²
Shear stress T/(2 A_m t)	41.667	MPa
Torsion constant 4A_m² t/s	180.00	cm⁴
Angle of twist	1.6117	°

Notes for this case

- Thin uniform wall (t much less than b and h); corners raise the stress locally.

Formula and method

$$\tau = \frac{T}{2A_m t}, \quad J = \frac{4A_m^2 t}{s}, \quad \theta = \frac{TL}{GJ}$$

Variables

T	Torque	N·m
b	Mean width (centre line of the wall)	m
h	Mean height	m
t_w	Wall thickness	m
L	Length	m
G	Shear modulus	Pa
A_m	Area enclosed by the wall centre line	m²
τ	Shear stress T/(2 A_m t)	Pa
J	Torsion constant 4A_m² t/s	m⁴
θ	Angle of twist	rad

Method and standards

Constant shear flow around a thin closed section.

Assumptions and limits

- The page warns when the wall exceeds a tenth of the smaller mean dimension (approximate) and when it reaches half of it (thin-wall theory invalid).
- Thin, uniform wall.

References

• Bredt–Batho thin-walled tube theory (Timoshenko, Strength of Materials)

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/thin-tube-torsion-bredt

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.