Anchor Bolt Tension and Shear for a Vertical Vessel or Stack

Maximum anchor bolt tension from overturning moment and weight on a bolt circle, the bolt shear, and the tensile and shear stresses on the bolt stress area.

Method: Ring section modulus of a bolt circle

Input parameters

Unit system: SI

Parameter	Value	Unit
Overturning moment at the base	800.00	kN·m
Minimum weight (empty)	300.00	kN
Base shear	60.000	kN
Number of bolts	16.000	
Bolt circle diameter	2.8000	m
Bolt tensile stress area	561.00	mm²

Calculated results

Parameter	Value	Unit
Maximum bolt tension	52.679	kN
Bolt tensile stress	93.901	MPa
Shear per bolt	3.7500	kN
Bolt shear stress	6.6845	MPa

Notes for this case

• T = 4M/(N·D_bc) − W/N: bolts on a circle behave like a thin ring of section modulus N·D_bc/4. If the result is zero or negative the weight alone holds the vessel down. Shear may be taken by friction or shear lugs instead; combine tension and shear with the user's code interaction and add bolt pretension effects.

Formula and method

$$T = \frac{4M}{ND_{bc}} - \frac{W_{min}}{N}, \quad \sigma_t = \frac{T}{A_s}, \quad \tau_b = \frac{V}{NA_s}$$

Variables

M	Overturning moment at the base	N·m
W_{min}	Minimum weight (empty)	N
V	Base shear	N
N	Number of bolts	-
D_{bc}	Bolt circle diameter	m
A_s	Bolt tensile stress area	m²
T	Maximum bolt tension	N
σ_t	Bolt tensile stress	Pa
V_b	Shear per bolt	N
τ_b	Bolt shear stress	Pa

Method and standards

Anchor bolts.

Assumptions and limits

- Rigid base ring; bolts equally stressed by position.

References

Ring section modulus of a bolt circle

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/vessels/anchor-bolt-tension-overturning

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.