Storage Tank Wind Overturning, Sliding and Anchor Load

Wind force, overturning moment, stability and sliding factors of safety of an empty vertical tank, and the anchor bolt tension needed.

Method: Rigid-body stability of a vertical tank under wind; Megyesy; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Tank diameter	12.000	m
Tank height	14.000	m
Empty mass (shell, roof, bottom)	45.000	t
Design wind speed	45.000	m/s
Force coefficient	0.70000	
Air density	1.2250	kg/m³
Base friction coefficient	0.40000	
Anchor bolts	24.000	

Calculated results

Parameter	Value	Unit
Wind pressure	1.2403	kPa
Wind force	145.86	kN
Overturning moment	1,021.0	kN·m
Overturning factor of safety	2.5933	
Sliding factor of safety	1.2102	
Anchor bolt tension (each)	0	kN

Notes for this case

• F = ½ρv²C_f·DH at mid-height; overturning about the base edge resisted by the empty weight at D/2. Anchor bolt tension 4M/(nD) − W/n on the bolt circle (taken as D). Wind speeds and factors with height, gusts and code safety factors come from your wind code.

Formula and method

$$F = \frac{1}{2}\rho v^2 C_f D H, \quad FS_o = \frac{mgD/2}{FH/2}, \quad T_b = \frac{4M_o}{n_b D} - \frac{mg}{n_b}$$

Variables

D	Tank diameter	m
H	Tank height	m
m	Empty mass (shell, roof, bottom)	kg
v	Design wind speed	m/s
C_f	Force coefficient	-
ρ	Air density	kg/m³
μ	Base friction coefficient	-
n_b	Anchor bolts	-
q	Wind pressure	Pa
F	Wind force	N

M_o	Overturning moment	N·m
FS_o	Overturning factor of safety	-
FS_s	Sliding factor of safety	-
T_b	Anchor bolt tension (each)	N

Method and standards

Tank stability.

Assumptions and limits

- Uniform wind on the projected area; rigid tank.

References

Rigid-body stability of a vertical tank under wind, Megyesy, Pressure Vessel Handbook (Pressure Vessel Publishing)

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/tank-wind-overturning

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.