Wedge Force to Raise or Lower a Load with Friction

Push needed to raise a guided load with a wedge, the force to withdraw it, efficiency and self-locking, from wedge angle and the friction on both faces.

Method: Friction on wedges

Input parameters

Unit system: SI

Parameter	Value	Unit
Load to raise	10.000	kN
Wedge angle	10.000	°
Friction coefficient, sloped face	0.25000	
Friction coefficient, base	0.25000	

Calculated results

Parameter	Value	Unit
Push to raise the load	6.9599	kN
Force to withdraw the wedge (negative: slips out on its own)	3.2056	kN
Efficiency when raising	25.335	%
Self-locking (1 = yes)	1.0000	

Notes for this case

• With the load guided to move only vertically, the reaction on the sloped face leans back by the friction angle $\varphi_1 = \arctan \mu_1$ from its normal, and the base reaction by φ_2. Equilibrium gives a raising push $P = W[\tan(\alpha + \varphi_1) + \tan \varphi_2]$. Withdrawing reverses both frictions: $P_{out} = W[\tan(\varphi_1 - \alpha) + \tan \varphi_2]$, which is positive (the wedge must be pulled, i.e. it is self-locking) when $\alpha < \varphi_1 + \varphi_2$. Efficiency is the frictionless push $W \tan \alpha$ over the actual push.

Formula and method

$$P = W[\tan(\alpha + \varphi_1) + \tan \varphi_2], \quad P_{out} = W[\tan(\varphi_1 - \alpha) + \tan \varphi_2]$$

Variables

W	Load to raise	N
α	Wedge angle	rad
μ_1	Friction coefficient, sloped face	-
μ_2	Friction coefficient, base	-
P_{raise}	Push to raise the load	N
P_{out}	Force to withdraw the wedge (negative: slips out on its own)	N
η	Efficiency when raising	-
$\mathrm{self-locking}$	Self-locking (1 = yes)	-

Method and standards

Wedge force.

Assumptions and limits

- Load guided vertically without friction; Coulomb friction; static.

References

Friction on wedges

Report details

Report reference	FCC-CJV1-NJBS (the same inputs always give the same reference)
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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/statics-dynamics/wedge-friction-force

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.