Coulomb Active Earth Pressure with Wall Friction

Coulomb active earth pressure coefficient and thrust on a retaining wall with wall friction, a sloping back and a sloping backfill, for a cohesionless soil.

Method: Coulomb's active earth pressure coefficient (Das, Principles of Foundation Engineering)

Input parameters

Unit system: SI

Parameter	Value	Unit
Soil friction angle	32.000	°
Wall friction angle	20.000	°
Back of wall from vertical (positive when it slopes away from the fill)	0	°
Backfill slope	0	°
Unit weight of the fill	18.000	kN/m³
Wall height	5.0000	m

Calculated results

Parameter	Value	Unit
Active coefficient	0.27554	
Active thrust per metre ½K_aγH²	61.996	kN/m
Horizontal component	58.257	kN/m
Vertical component	21.204	kN/m

Notes for this case

- The thrust acts at H/3 above the base, inclined at δ to the normal of the wall back.

Formula and method

$$K_a = \frac{\cos^2(\phi - \theta)}{\cos^2\theta\cos(\delta+\theta)\left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\beta)}{\cos(\delta+\theta)\cos(\theta-\beta)}}\right]^2}$$

Variables

ϕ	Soil friction angle	rad
δ	Wall friction angle	rad
θ	Back of wall from vertical (positive when it slopes away from the fill)	rad
β	Backfill slope	rad
γ	Unit weight of the fill	N/m³
H	Wall height	m
K_a	Active coefficient	-
P_a	Active thrust per metre ½K_aγH²	N/m
P_h	Horizontal component	N/m
P_v	Vertical component	N/m

Method and standards

Coulomb wedge theory.

Assumptions and limits

- Dry cohesionless backfill, planar wedge; δ not above φ.

- Sign of θ: positive when the back of the wall slopes away from the fill going up, so the fill overhangs the wall back; this raises K_a (θ = 10°, φ = 30°, δ = β = 0 gives 0.407 against 0.333 for a vertical back). Negative θ (back leaning into the fill) lowers it.

References

- Coulomb's active earth pressure coefficient (Das, Principles of Foundation Engineering)

Report details

Report reference	FCC-Q6WH-89P5 (the same inputs always give the same reference)
Generated	17 November 2026, 19:36 UTC
Calculator	Coulomb Active Earth Pressure with Wall Friction
Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/geotechnical/coulomb-active-pressure

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.