Wind Velocity Pressure and Force on a Surface

Wind speed at a height by the power law, the velocity pressure ½ρV², and the force on a surface or member from its force coefficient and area.

Method: Velocity pressure q = ½ρV² with the power-law wind profile (Simiu and Scanlan, Wind Effects on Structures)

Input parameters

Unit system: SI

Parameter	Value	Unit
Reference wind speed Use the averaging time your code and the exponent α are based on (hourly mean, 10-minute mean or 3-second gust): mixing them changes q by up to about 2 times.	39.000	m/s
Reference height	10.000	m
Height of interest	20.000	m
Power-law exponent (terrain)	0.14000	
Air density	1.2250	kg/m³
Force (shape) coefficient	1.3000	
Projected area	20.000	m²

Calculated results

Parameter	Value	Unit
Wind speed at z	42.974	m/s
Velocity pressure	1.1312	kPa
Wind force	29.410	kN

Notes for this case

• Power-law profile: α about 0.10 over sea, 0.14 open country, 0.22 suburbs, 0.33 city centres. Design to your building code's basic speed, terrain, topography and importance factors; this page shows the physics.

Formula and method

$$V_z = V_r \left(\frac{z}{z_r}\right)^{\alpha}, \quad q_z = \frac{1}{2}\rho V_z^2, \quad F = C_f q_z A$$

Variables

V_r	Reference wind speed	m/s
z_r	Reference height	m
z	Height of interest	m
α	Power-law exponent (terrain)	-
ρ	Air density	kg/m³
C_f	Force (shape) coefficient	-
A	Projected area	m²
V_z	Wind speed at z	m/s
q_z	Velocity pressure	Pa
F	Wind force	N

Method and standards

Velocity pressure.

Assumptions and limits

- The averaging time of V_r (hourly mean, 10-minute mean or 3-second gust) must match the profile exponent and the code's

coefficients; the page does not know which one was entered.
- Steady wind; neutral atmosphere.

References
- Velocity pressure q = ½ρV² with the power-law wind profile (Simiu and Scanlan, Wind Effects on Structures)

Report details

Report reference	FCC-XFY0-EHT4 (the same inputs always give the same reference)
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Release checks	2 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/steel/wind-pressure-force

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