Suspension Wheel Rate from Spring Rate and Motion Ratio

Wheel rate from spring rate, motion ratio and spring inclination, the ride rate with tyre stiffness in series, and the ride frequency of a corner mass.

Method: Suspension installation ratio

Input parameters

Unit system: SI

Parameter	Value	Unit
Spring rate	60.000	N/mm
Motion ratio (spring travel / wheel travel)	0.70000	
Spring inclination from the direction of travel	10.000	°
Tyre vertical stiffness	250.00	N/mm
Sprung mass at the corner	350.00	kg

Calculated results

Parameter	Value	Unit
Wheel rate	28.513	N/mm
Ride rate (with tyre)	25.594	N/mm
Ride frequency	1.3610	Hz

Notes for this case

• k_w = k_s(MR·cosθ)²: the motion ratio enters squared, once for force and once for travel. The tyre acts as a spring in series, k_r = k_wk_t/(k_w + k_t). Road cars ride at about 1–1.5 Hz, sports cars 1.5–2 Hz, downforce race cars 3–5 Hz; rear usually slightly higher than front to reduce pitch.

Formula and method

$$k_w = k_s(MR\cos\theta)^2, \quad k_r = \frac{k_w k_t}{k_w + k_t}, \quad f = \frac{1}{2\pi}\sqrt{\frac{k_r}{m_c}}$$

Variables

k_s	Spring rate	N/m
MR	Motion ratio (spring travel / wheel travel)	-
θ	Spring inclination from the direction of travel	rad
k_t	Tyre vertical stiffness	N/m
m_c	Sprung mass at the corner	kg
k_w	Wheel rate	N/m
k_r	Ride rate (with tyre)	N/m
f	Ride frequency	1/s

Method and standards

Wheel rate.

Assumptions and limits

- Linear motion ratio near ride height.

References

Suspension installation ratio

Report details

Report reference	FCC-FWAS-VQ8R (the same inputs always give the same reference)
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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/automotive/vehicle-dynamics/suspension-wheel-rate-motion-ratio

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.