Suspension Wheel Rate, Ride Rate and Natural Frequency

Wheel rate from spring rate and motion ratio, ride rate in series with the tyre, ride natural frequency and static deflection of one corner of a vehicle.

Method: Quarter-car ride rate

Input parameters

Unit system: SI

Parameter	Value	Unit
Sprung mass on the corner	380.00	kg
Spring rate	35.000	N/mm
Motion ratio (spring travel / wheel travel)	0.90000	
Tyre vertical stiffness	200.00	N/mm

Calculated results

Parameter	Value	Unit
Wheel rate	28.350	N/mm
Ride rate (with tyre)	24.830	N/mm
Ride natural frequency	1.2865	Hz
Static deflection	150.08	mm

Notes for this case

• k_w = k_s·MR², tyre in series, f = √(k_r/m)/2π. Comfort cars run about 1.0–1.3 Hz, sports cars 1.5–2.0 Hz, race cars with downforce much higher; rear usually 10–20 % above front to limit pitch.

Formula and method

$$k_w = k_s MR^2, \quad k_r = \frac{k_w k_t}{k_w + k_t}, \quad f_n = \frac{1}{2\pi}\sqrt{\frac{k_r}{m_s}}$$

Variables

m_s	Sprung mass on the corner	kg
k_s	Spring rate	N/m
MR	Motion ratio (spring travel / wheel travel)	-
k_t	Tyre vertical stiffness	N/m
k_w	Wheel rate	N/m
k_r	Ride rate (with tyre)	N/m
f_n	Ride natural frequency	1/s
δ_{st}	Static deflection	m

Method and standards

Ride rate.

Assumptions and limits

- Linear springs; single degree of freedom.

References

Quarter-car ride rate

Report details

Report reference	FCC-WDGD-ZCBT (the same inputs always give the same reference)
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Calculator	Suspension Wheel Rate, Ride Rate and Natural Frequency
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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-ride-frequency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.