Limited-Slip Differential Torque Bias and Traction

Drive torque delivered by an open and a limited-slip differential when one wheel is on low grip, from the torque bias ratio, wheel load and friction on each side.

Method: Torque-sensing differential statics

Input parameters

Unit system: SI

Parameter	Value	Unit
Torque bias ratio	3.0000	
Load on each driven wheel	4,500.0	N
Friction on the low-grip side	0.15000	
Friction on the high-grip side	0.90000	
Tyre dynamic radius	320.00	mm

Calculated results

Parameter	Value	Unit
Total axle torque, open differential	432.00	N·m
Low-side wheel torque	216.00	N·m
High-side wheel torque, LSD	648.00	N·m
Total axle torque, LSD	864.00	N·m
Traction gain	2.0000	

Notes for this case

• An open differential splits torque equally, so the axle can only deliver twice what the slipping wheel supports. A torque-sensing LSD lets the high side carry up to TBR times the low side, limited by its own grip. Preloaded or locking designs differ; TBR comes from the differential's design or test.

Formula and method

$$T_{open} = 2\mu_l F_z r_d, \quad T_{high} = \min(TBR \cdot \mu_l F_z r_d,\ \mu_h F_z r_d)$$

Variables

TBR	Torque bias ratio	-
F_z	Load on each driven wheel	N
μ_l	Friction on the low-grip side	-
μ_h	Friction on the high-grip side	-
r_d	Tyre dynamic radius	m
T_{open}	Total axle torque, open differential	N·m
T_{low}	Low-side wheel torque	N·m
T_{high}	High-side wheel torque, LSD	N·m
T_{LSD}	Total axle torque, LSD	N·m
T_{LSD}/T_{open}	Traction gain	-

Method and standards

Torque bias.

Assumptions and limits

- Quasi-static; equal wheel loads.

References

Torque-sensing differential statics

Report details

Report reference	FCC-KHWJ-1WTQ (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/transmission/limited-slip-torque-bias

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.