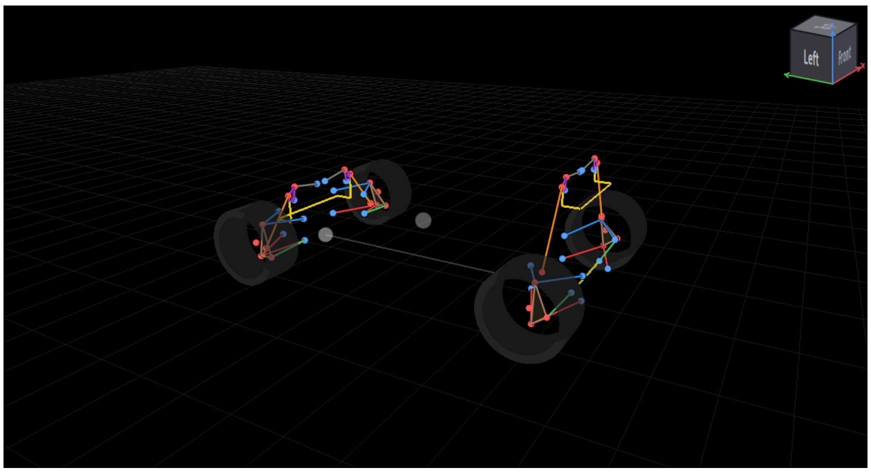
Vehicle Dynamics Report

Generated by Vahan · May 06, 2026



1 — Vehicle Parameters

Key geometry and mass properties used for all simulations.

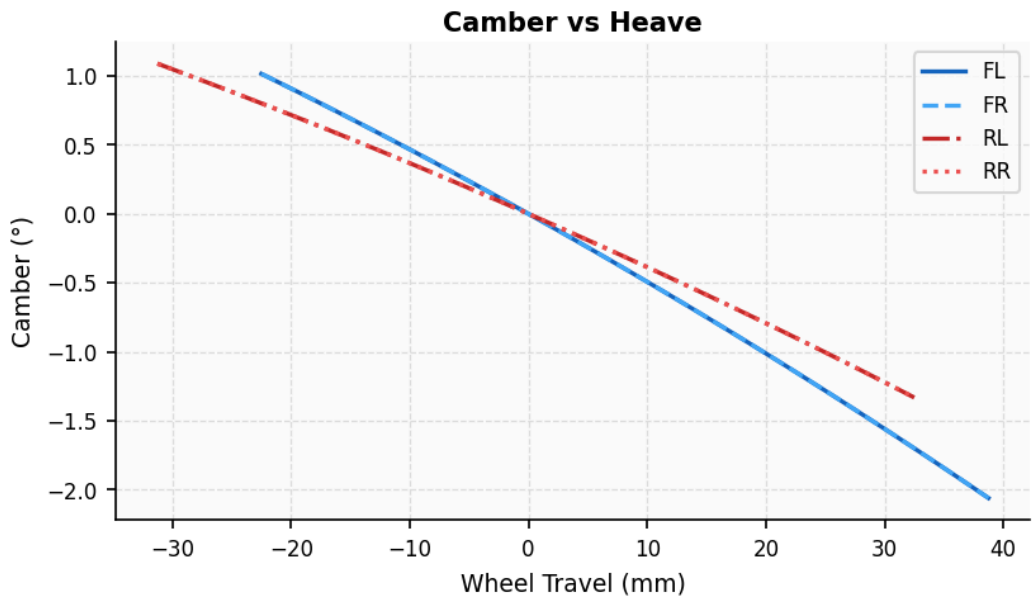
Parameter	Value	Unit
Wheelbase	1537	mm
Front Track	1222	mm
Rear Track	1200	mm
CG to Front Axle	845.0	mm
CG to Rear Axle	692.0	mm
CG Height	280.0	mm
Front Weight Distribution	45.0	%
Rear Weight Distribution	55.0	%
Total Mass	290.4	kg
Sprung Mass	223.8	kg
Unsprung Mass (est.)	66.6	kg
Engine Power	75	hp
Peak Tire μ	1.50	—
Wheel Rate (Front)	14000	N/m
Wheel Rate (Rear)	14000	N/m
Front Brake Bias	65	%

Design Rationale: Replace this text with your engineering justification.

2 — Suspension Kinematics: Heave

Static vertical travel sweep. Shows how each kinematic quantity changes as the suspension compresses and extends symmetrically. Range: -50 to 50 mm.

2.1 — Camber vs Wheel Travel

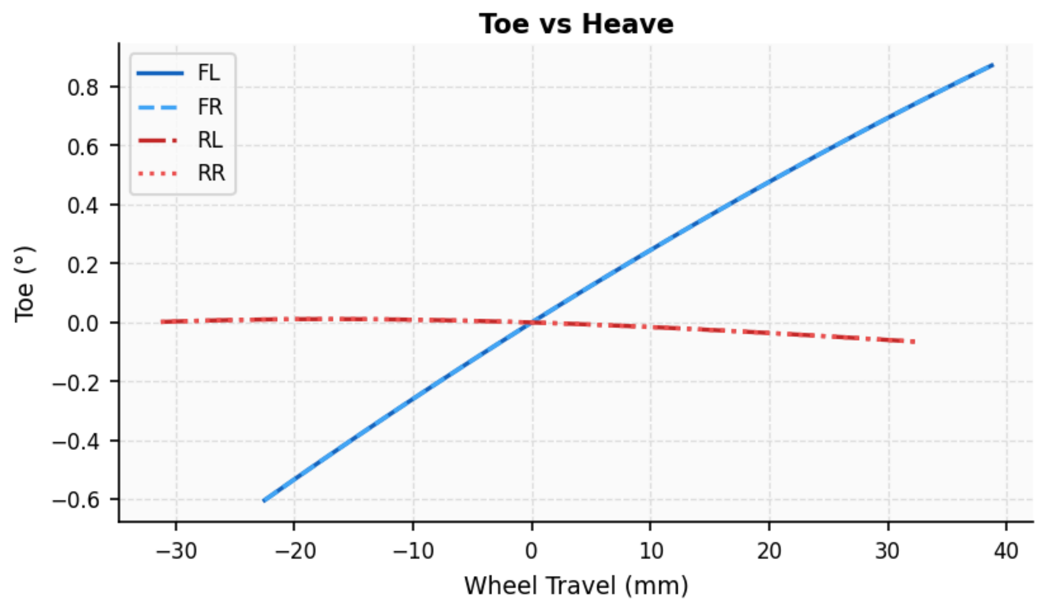


Negative camber = tire leans inward. Target: gain negative camber in bump.

Analysis: *Front: +nan deg/mm (gaining positive camber in bump)* | *Rear: +nan deg/mm (gaining positive camber in bump)*

Design Rationale: Replace this text with your engineering justification.

2.2 — Toe vs Wheel Travel

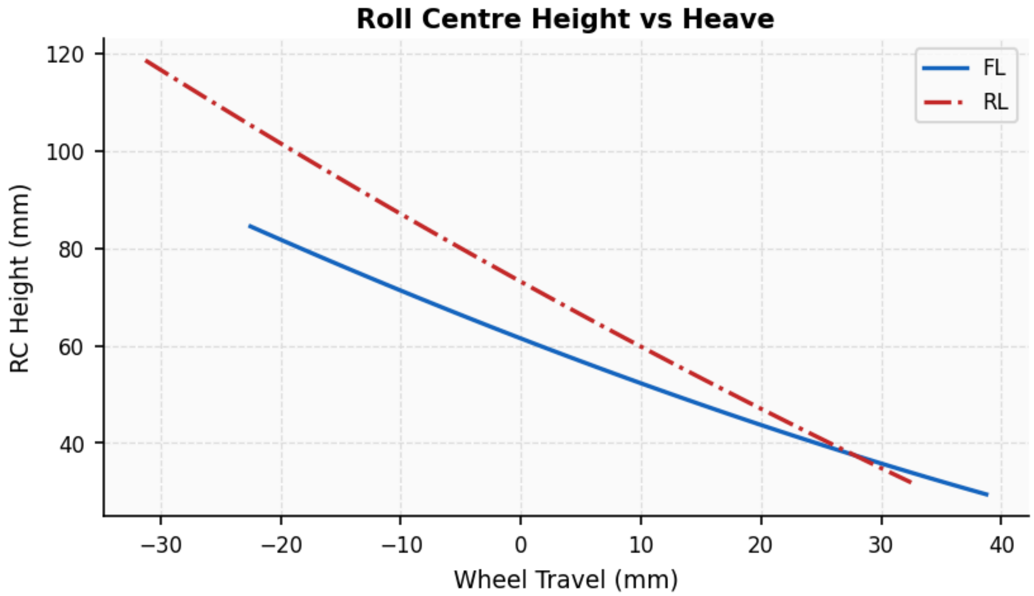


Positive toe = toe-out. Bump-toe-in (rear) improves stability.

Analysis: *Front: +nan ° bump toe-out over range. Rear: +nan ° bump toe-out over range.*

Design Rationale: Replace this text with your engineering justification.

2.3 — Roll Centre Height vs Wheel Travel

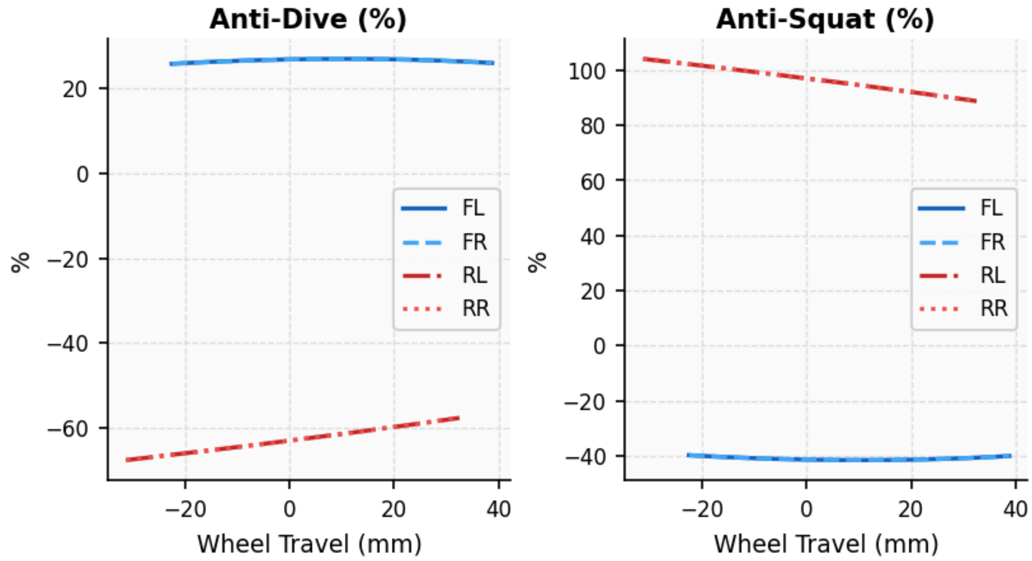


Front and rear RC height. Migration under heave drives jacking force.

Analysis: *Front RC migrates +nan mm over full heave range | Rear RC migrates +nan mm over full heave range*

Design Rationale: Replace this text with your engineering justification.

2.4 — Anti-Dive & Anti-Squat

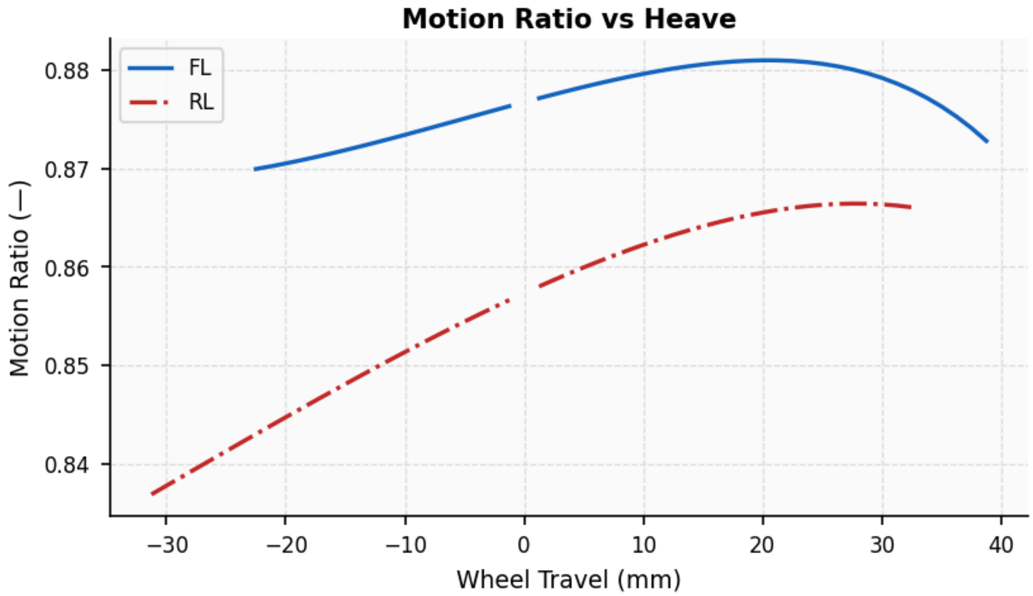


Anti-dive (front) and anti-squat (rear). 100 % = full geometric resistance to pitch.

Analysis: *Anti-dive (design pos): 26.9 %. Anti-squat (design pos): 97.0 %.*

Design Rationale: Replace this text with your engineering justification.

2.5 — Motion Ratio vs Wheel Travel



MR = d(spring) / d(wheel). < 1 = spring moves less than wheel.

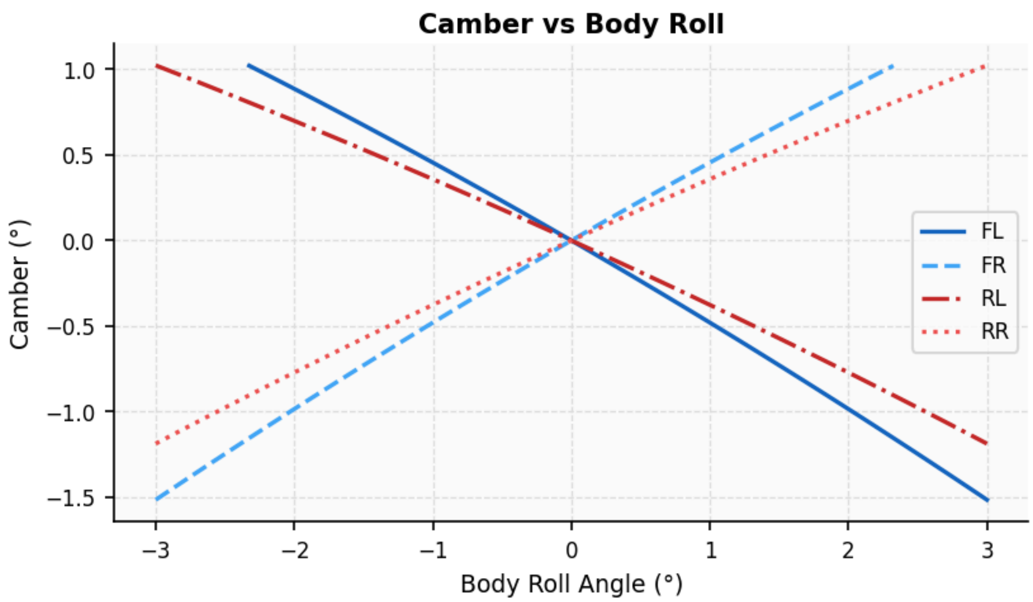
Analysis: *Front MR at design pos: nan. Rear MR at design pos: nan.*

Design Rationale: Replace this text with your engineering justification.

3 — Suspension Kinematics: Roll

Body roll sweep -3.0 ° to 3.0 °. Shows camber recovery — how well the outer tire stays upright as the body rolls.

3.1 — Camber vs Roll Angle

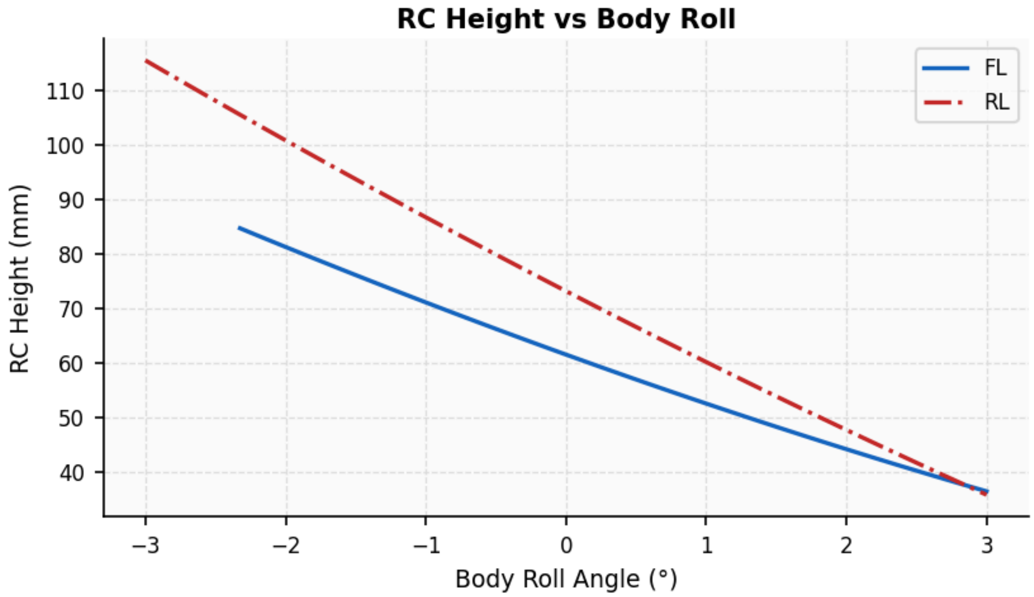


Ideal: outer tire (FL at positive roll) gains negative camber — stays flat on road.

Analysis: *FL (outside) camber: -1.52 ° at 3.0 ° body roll — good negative recovery.*

Design Rationale: Replace this text with your engineering justification.

3.2 — RC Height vs Roll Angle



RC migration during body roll couples with jacking force.

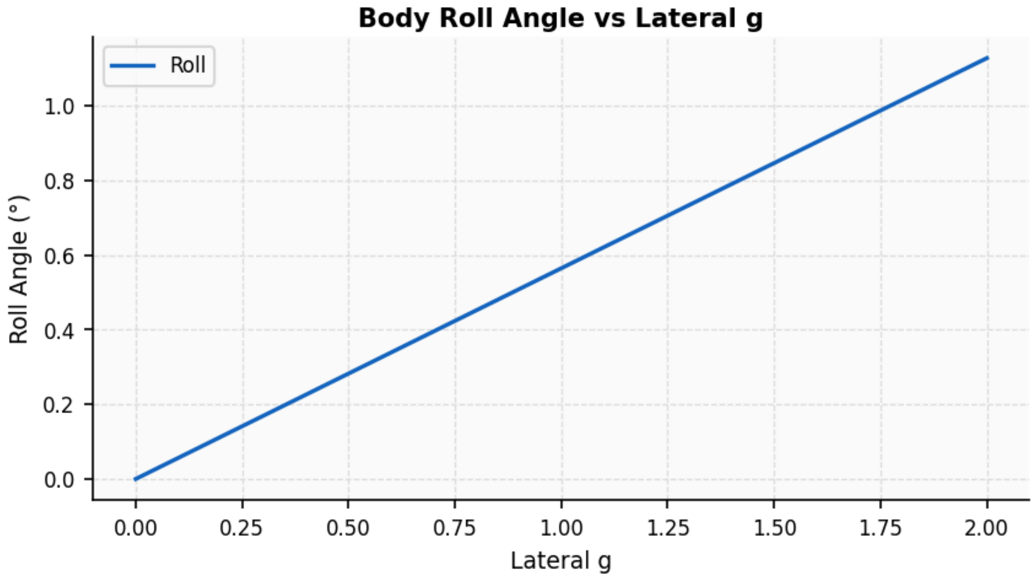
Analysis: *Front RC migrates -25.1 mm over full heave range | Rear RC migrates -37.4 mm over full heave range*

Design Rationale: Replace this text with your engineering justification.

4 — Steady-State Cornering

Lateral-g sweep 0 – 2.0 g (pure cornering, lon-g = 0). Steady-state load transfer, roll, utilization.

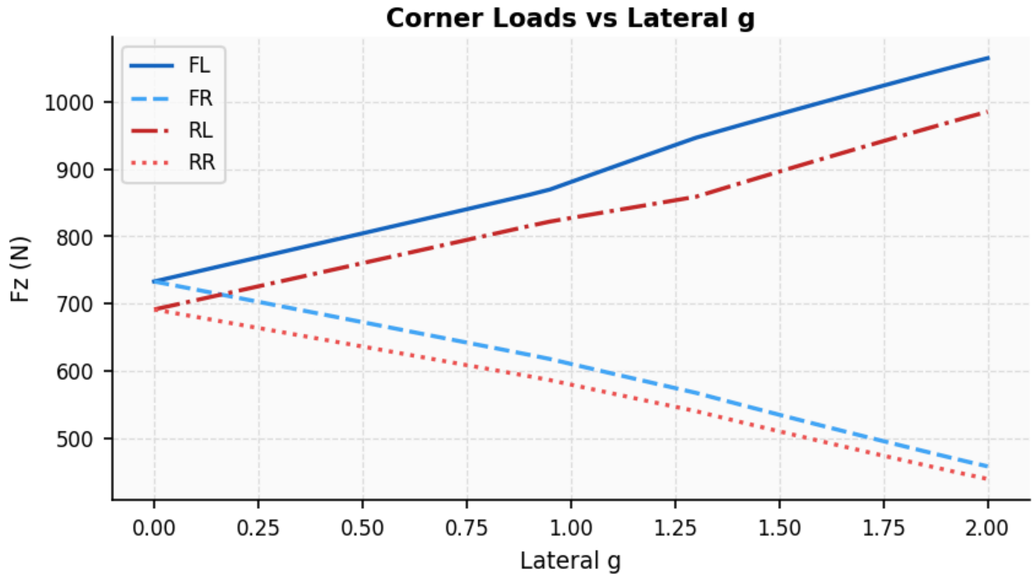
4.1 — Body Roll Angle



Analysis: *Peak body roll 1.1 ° — within a typical FSAE 1–3 ° target.*

Design Rationale: Replace this text with your engineering justification.

4.2 — Corner Tire Loads (Fz)

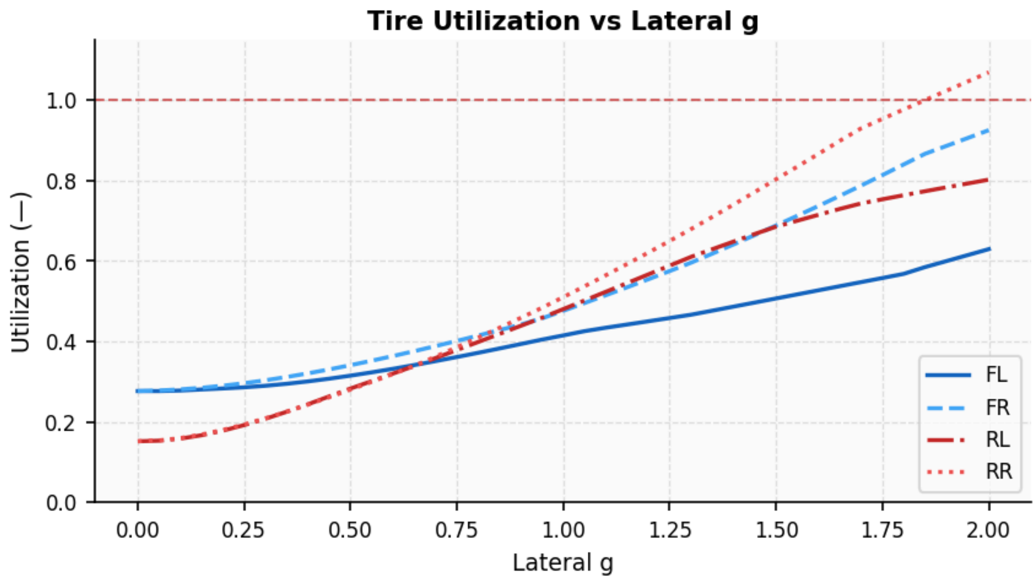


Inner tires unload; outer tires load up. LT ratio determines handling balance.

Analysis: *At 1 g: front lateral load transfer -18 % (outside/inside Fz), rear -18 %.*

Design Rationale: Replace this text with your engineering justification.

4.3 — Tire Utilization (Friction Circle)

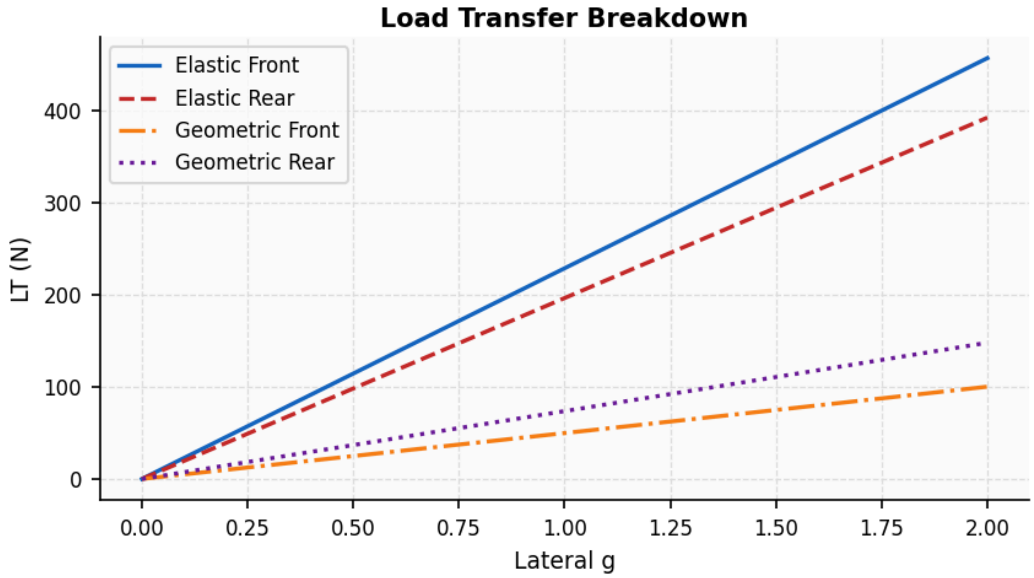


1.0 = tire fully saturated. Dashed line = limit.

Analysis: *First tire approaches saturation (≥ 95 %) at 1.75 g — RR corner leads.*

Design Rationale: Replace this text with your engineering justification.

4.4 — Lateral Load Transfer Breakdown

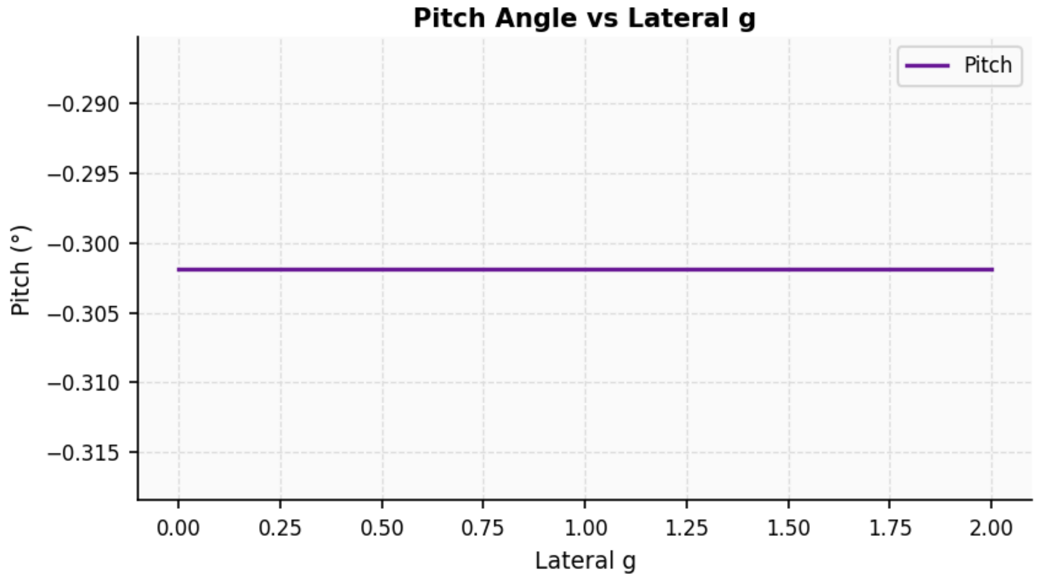


Elastic LT via springs + ARBs. Geometric LT via RC height. Higher geometric LT front = understeer tendency.

Analysis: *At 1 g: LLTD front 51 % / rear 49 %. Balanced split.*

Design Rationale: Replace this text with your engineering justification.

4.5 — Pitch Angle during Cornering



Small pitch change during pure cornering from Fz asymmetry.

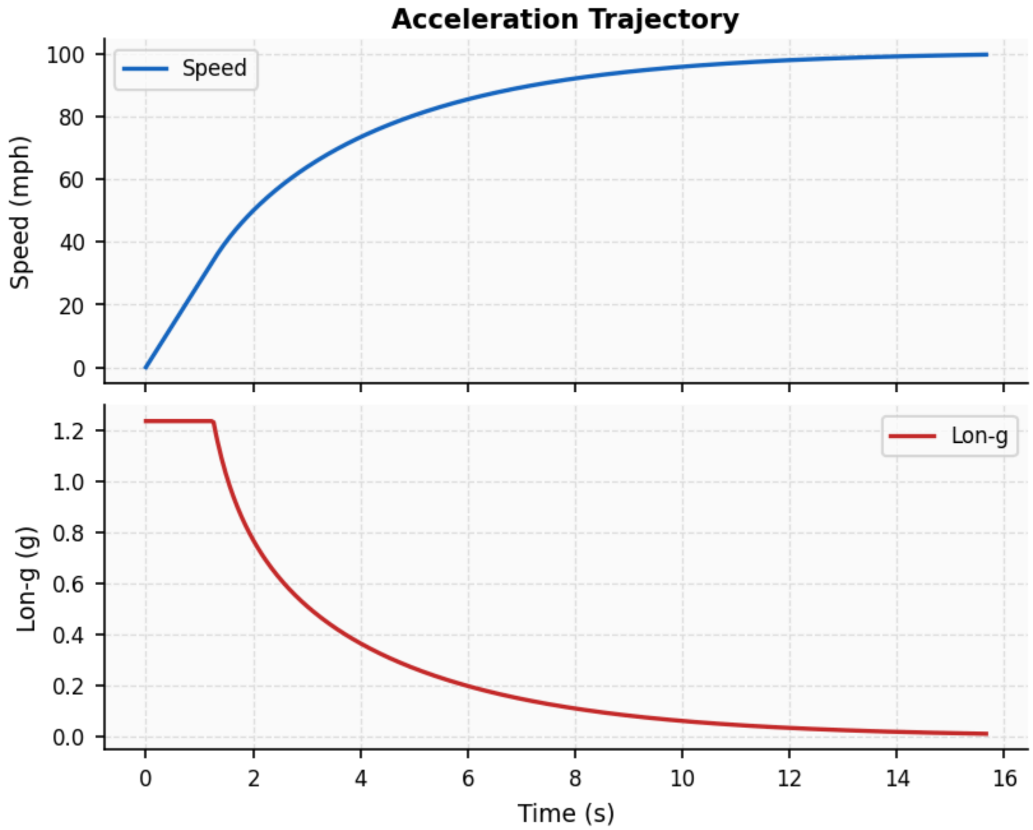
Analysis: *Pitch angle at 1 g lateral: -0.30 °. Pure cornering pitch change reflects CG height + load transfer asymmetry.*

Design Rationale: Replace this text with your engineering justification.

5 — Straight-Line Acceleration

Full-throttle trajectory from 0 mph. Duration: 15.7 s, terminal: 100 mph.

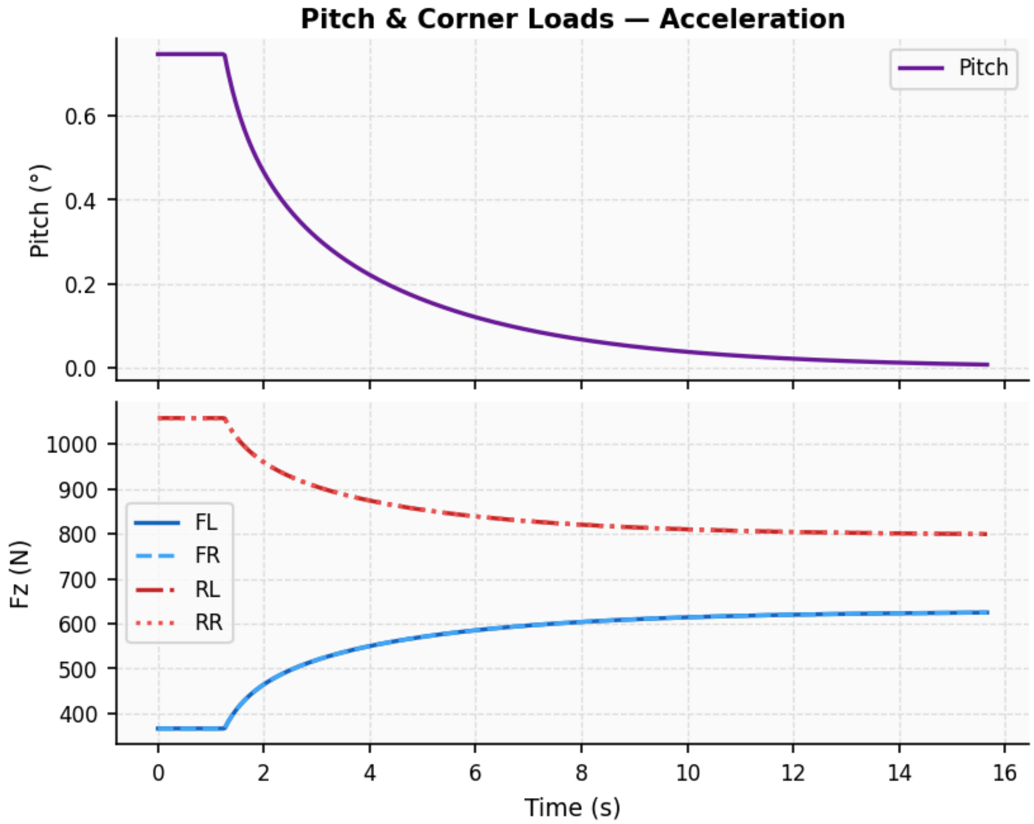
5.1 — Speed & Achieved Longitudinal g



Analysis: *0–100 mph in 15.7 s. Peak achieved traction 1.24 g — limited by drivetrain + traction. Nose raises 0.75 ° at peak accel (weight transfer to rear).*

Design Rationale: Replace this text with your engineering justification.

5.2 — Pitch & Tire Loads



Nose rises as weight shifts to driven rear axle.

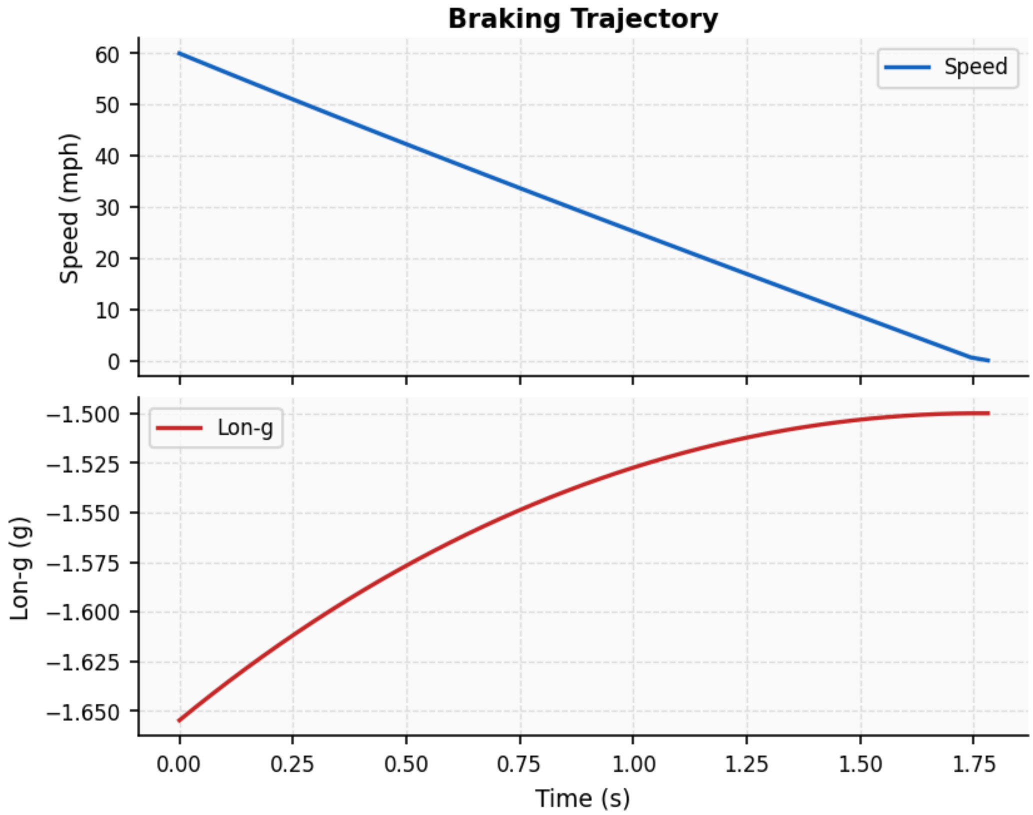
Analysis: *At launch: front Fz 366 N, rear Fz 1058 N. Pitch 0.75 ° — driven by weight transfer to rear.*

Design Rationale: Replace this text with your engineering justification.

6 — Straight-Line Braking

Max-braking trajectory from 60 mph. Stops in 1.78 s.

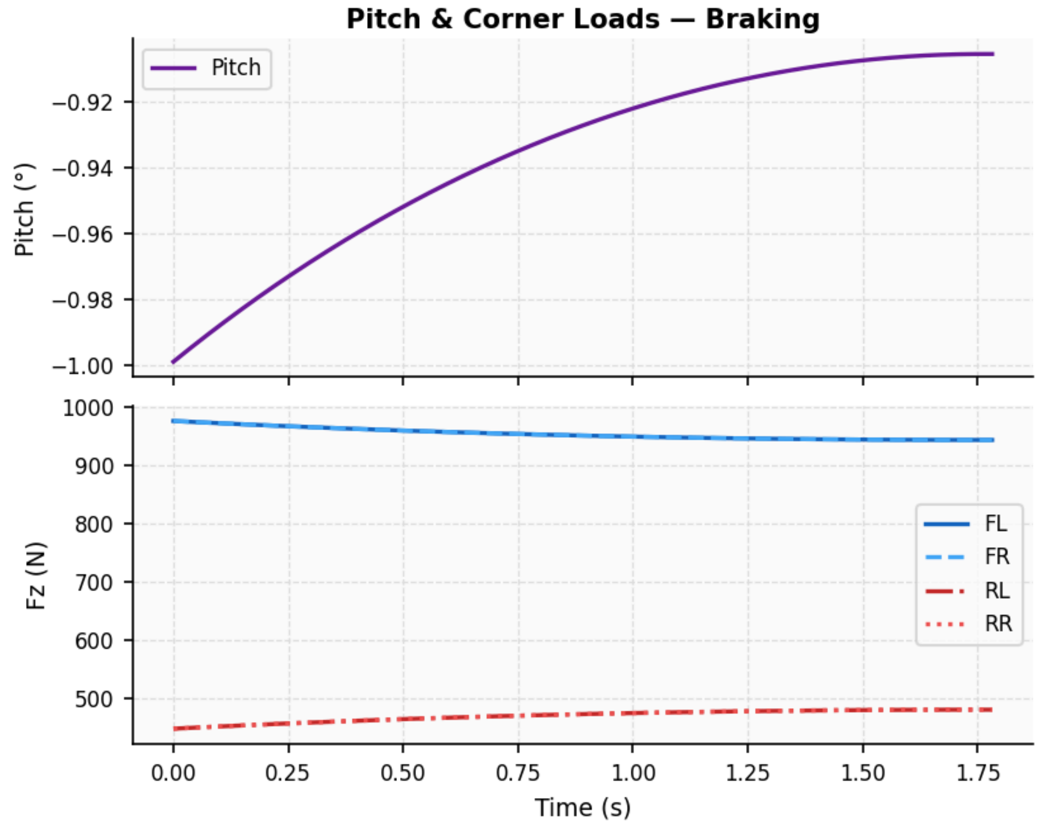
6.1 — Speed & Decel g



Analysis: *60 → 0 mph in 1.8 s (60 mph shed). Peak decel 1.65 g — friction + aero drag. Nose dives 1.00 ° at peak braking (weight transfer to front).*

Design Rationale: Replace this text with your engineering justification.

6.2 — Pitch & Tire Loads



Nose dives as weight shifts forward. Rear tires unload.

Analysis: *Front Fz peaks at 977 N (FL). Rear unloads to 448 N min (RL).*

Design Rationale: Replace this text with your engineering justification.

7 — Component Loads

Member forces and joint reactions at 1.70 g lateral, -0.50 g longitudinal (current panel state).

7.1 — Suspension Member Axial Forces

Positive = tension (pulled apart). Negative = compression.

Member	FL	FR	RL	RR
UCA front arm	+1836	+1009	+2145	+1167
UCA rear arm	-1500	-1359	-1505	-1131
LCA front arm	-5224	-2581	-6040	-3240
LCA rear arm	+3167	+2859	+3355	+2580
Tie rod	+776	+401	+619	+292
Pushrod	+1090	+420	+1771	+942
Spring (comp+)	+955	+368	+1519	+808

7.2 — Ball Joint Reactions (V=up+, H=fwd+)

Joint	FL	FR	RL	RR
UCA BJ V	-24	-84	+83	+8
UCA BJ H	+1600	+1105	+1556	+976
LCA BJ V	-112	-61	+349	+276
LCA BJ H	-2940	-1933	-3226	-2011
Tie Rod BJ V	+71	+11	-19	-31
Tie Rod BJ H	-8	-4	+30	+12
Pushrod BJ V	-951	-368	-1345	-734
Pushrod BJ H	+0	-0	+3	-2

7.3 — Bearing & Caliper Bolt Loads

Load	FL	FR	RL	RR
Bearing inner V	+688	+483	+525	+344
Bearing inner H	-96	-96	-52	-52
Bearing outer V	+1032	+724	+787	+516
Bearing outer H	-145	-145	-78	-78
Caliper upper V	-352	-352	-189	-189
Caliper upper H	+1918	+1918	+1033	+1033
Caliper lower V	-352	-352	-189	-189
Caliper lower H	-1214	-1214	-654	-654

Analysis: *Peak pushrod: 1771 N. Peak tie rod: 776 N. Peak spring: 1519 N. At 1.70g lat / -0.50g lon.*

Design Rationale: Replace this text with your engineering justification.