Haul Truck Stopping Distance on a Downgrade and Safe Spacing

Stopping distance of an off-highway truck from speed, downgrade, brake and driver reaction time and tyre-road friction, and the safe following distance.

Input parameters

Unit system: SI

Parameter	Value	Unit
Speed when the hazard is seen	40.000	km/h
Downgrade (positive downhill)	8.0000	%
Brake system reaction time	2.7500	s
Driver reaction time	1.5000	s
Tyre-road friction coefficient (about 0.3)	0.30000	
Coefficient of traction (following distance)	0.50000	

Calculated results

Parameter	Value	Unit
Stopping distance	102.52	m
Distance travelled during the reaction times	54.285	m
Safe distance between trucks	42.220	m
Angle of descent	4.5739	°

Notes for this case

- Kaufman and Ault's formula; brake reaction is about 1.5 s for 100,000-200,000 lb trucks, 2.75 s for 200,000-400,000 lb and 4.5 s or more above that. The British Columbia limit on stopping distance is about 61 m (200 ft); check with the truck maker's brake data.
- The stopping distance exceeds about 61 m, the guide limit beyond which brake fade becomes likely.

Formula and method

$$SD = \frac{1}{2} g t^2 \sin\theta + V_o t + \frac{(g t \sin\theta + V_o)^2}{2g(U_{min} - \sin\theta)}, \quad t = t_1 + t_2$$

$$d_b = \frac{2.0 v}{3.6} + \frac{v^2}{254(C_t - i)} + 5.0 \text{ m}$$

Variables

V_o	Speed when the hazard is seen	m/s
i	Downgrade (positive downhill)	-
t_1	Brake system reaction time	s
t_2	Driver reaction time	s
U_{min}	Tyre-road friction coefficient (about 0.3)	-
C_t	Coefficient of traction (following distance)	-
SD	Stopping distance	m
s_r	Distance travelled during the reaction times	m
d_b	Safe distance between trucks	m
θ	Angle of descent	rad

Method and standards

Kaufman and Ault stopping distance; Atkinson safe spacing.

Assumptions and limits

- Empirical; brake fade not included.

Report details

Report reference	FCC-Q28M-FBZ1 (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/civil/mine-design/haul-truck-stopping-distance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.