Vehicle Road Load Requirement

\[ P_b = \frac{1}{\eta_T} (F_R + F_D + F_a + F_C) S_V \]

\( P_b \) = Required engine brake power output
\( \eta_T \) = Transmission efficiency
\( F_R \) = Rolling frictional force \( (= C_R M g \cos(\alpha) ; C_R \sim 0.015) \)
\( F_D \) = Aerodynamic drag force \( (= 0.5 \rho_a S_v^2 C_D A_v ; C_D \sim 0.3) \)
\( F_a \) = Force to provide acceleration \( (= M a) \)
\( F_C \) = Force for climbing incline \( (= M g \sin(\alpha)) \); negative for downhill
\( S_v \) = Vehicle speed
Truck Road Load Requirement

- Power required (kW)
  - 0
  - 100
  - 200
  - 300
  - 400
  - 500
  - 600
  - 700
  - 800

- Hill climbing
- Aerodynamic drag
- Rolling friction

- 1/10 grade power required
- Level road power required

20,000 lb truck

Power required (kW) vs. MPH
Vehicle speed and engine rpm are related

\[ S_v = \frac{N \pi d}{G.R.} \]

\( S_v \) = Vehicle speed  
\( N \) = Engine revolution per second ( = RPM / 60)  
\( G.R. \) = Overall gear ratio  
\( d \) = External diameter of tire

BMEP of engine

\[ \text{BMEP} = \frac{P_b}{V_D N/\eta_R} \]

\( V_D \) = Engine displacement  
\( \eta_R \) = 1 for two-stroke engine; 2 for four-stroke engine
Passenger car SI engine map

5th gear, 5% incline

4th gear, 5% incline

5th gear, flat road

4th gear, flat road

Relative efficiency = 1

Data from SAE 910676; 5th gear; 35 mph; 70 mph; 3rd gear; 70 mph; Saturn I4 engine