Resistance

1. Air resistance (مقاومة الهواء)

\[ R_a = \frac{C_D A \rho v^2}{2} \text{ Newtons} \]

\[ R_a = \text{Air Resistance ( N)} \]
\[ C_D = \text{aerodynamic drag coefficient} \]
\[ = 0.4 \text{ for passenger car and 0.5 for trucks} \]
\[ A = \text{Frontal cross - section area (m}^2) \]
\[ \rho = \text{air density (kg/m}^3) > 1.24 \text{ kg/m}^3. \]
\[ V = \text{vehicle speed (m/s)} \]

2. Rolling (الدوران)

Function of Velocity & Surface type

A- For passenger car:

\[ R_r = (C_{rs} + C_{rv} * V^2) W g \]

\[ R_r = \text{Rolling Resistance ( N)} \]
\[ C_{rs} = 0.012 \text{ for passenger car.} \]
\[ C_{rv} = 7 \times 10^{-6} \text{ for passenger car.} \]
\[ V = \text{vehicle speed (m/s)} \]
\[ W = \text{gross vehicle weight ( Kg)} \]
\[ g = \text{Acceleration of gravity} = 9.81 \text{ g/s}^2 \]

B- For trucks:

\[ R_r = (C_{rs} + C_{rv} * V) W g \]

\[ R_r = \text{Rolling Resistance ( N)} \]
\[ C_{rs} = 0.02445 \text{ for trucks.} \]
\[ C_{rv} = 0.00147 \text{ for trucks.} \]
\[ V = \text{vehicle speed (m/s)} \]
\[ W = \text{gross vehicle weight ( Kg)} \]
\[ g = \text{Acceleration of gravity} = 9.81 \text{ g/s}^2 \]

3. Curve (المنحنيات)

It is a function of the radius or degree of curvature and vehicle speed

\[ R_c = \frac{V^2 W}{2R} \]

\[ R_c = \text{Curve Resistance ( N)} \]
\[ V = \text{vehicle speed (m/s)} \]
\[ W = \text{gross vehicle weight ( Kg)} \]
\[ R = \text{radius of curvature (m)} \]
4. Grade

\[ R_g = W \cdot g \cdot \frac{G}{100} \]

\( R_g \) = Grade resistance (N)
\( W \) = gross vehicle weight (Kg)
\( g \) = Acceleration of gravity = 9.81 g/s²
\( G \) = road grade.

Power requirements

\[ P = \frac{RV}{746} \text{ (Hp)} \]

\[ R = \sum R_i = R_g + R_r + R_c + R_a \text{ Newton} \]

\( V \) = velocity m/s