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Mechanics of Train Movement Formulas

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List of 13 Mechanics of Train Movement Formulas

Mechanics of Train Movement

1) Accelerating Weight of Train

Open Calculator

fx $$W_e = W \cdot 1.10$$

ex $$33000\text{AT (US)} = 30000\text{AT (US)} \cdot 1.10$$

2) Aerodynamic Drag Force

Open Calculator

fx $$F_{drag} = C_{drag} \cdot \left(\frac{\rho \cdot V_f^2}{2} \right) \cdot A_{ref}$$

ex $$1091.374\text{N} = 1.39 \cdot \left(\frac{98\text{kg/m}^3 \cdot (6.4\text{km/h})^2}{2} \right) \cdot 5.07\text{m}^2$$

3) Coefficient of Adhesion

Open Calculator

fx $$\mu = \frac{F_t}{W}$$

ex $$0.622857 = \frac{545\text{N}}{30000\text{AT (US)}}$$

4) Crest Speed given Time for Acceleration

Open Calculator

fx $V_m = t_\alpha \cdot \alpha$

ex $98.352\text{km/h} = 6.83\text{s} \cdot 14.40\text{km/h*s}$

5) Gradient of Train for Proper Movement of Traffic

Open Calculator

fx $G = \sin(\angle D) \cdot 100$

ex $0.523596 = \sin(0.3^\circ) \cdot 100$

6) Retardation of Train

Open Calculator

fx $\beta = \frac{V_m}{t_\beta}$

ex $10.36354\text{km/h*s} = \frac{98.35\text{km/h}}{9.49\text{s}}$

7) Rotating Speed of Driven Wheel

Open Calculator

fx $N_w = \frac{N_{pp}}{i \cdot i_o}$

ex $956.6667\text{rev/min} = \frac{4879\text{rev/min}}{2.55 \cdot 2}$

8) Schedule Speed

Open Calculator

fx $$V_s = \frac{D}{T_{run} + T_{stop}}$$

ex $$25.12987\text{km/h} = \frac{258\text{km}}{10\text{h} + 16\text{min}}$$

9) Schedule Time

Open Calculator

fx $$T_s = T_{run} + T_{stop}$$

ex $$10.26667\text{h} = 10\text{h} + 16\text{min}$$

10) Time for Acceleration

Open Calculator

fx $$t_\alpha = \frac{V_m}{\alpha}$$

ex $$6.829861\text{s} = \frac{98.35\text{km/h}}{14.40\text{km/h*s}}$$

11) Time for Retardation

Open Calculator

fx $$t_\beta = \frac{V_m}{\beta}$$

ex $$9.493243\text{s} = \frac{98.35\text{km/h}}{10.36\text{km/h*s}}$$

12) Translational Speed of Wheel Center

Open Calculator

$$V_t = \frac{\pi \cdot r_d \cdot N_{pp}}{30 \cdot i \cdot i_o}$$

$$162.2947\text{km/h} = \frac{\pi \cdot 0.45\text{m} \cdot 4879\text{rev/min}}{30 \cdot 2.55 \cdot 2}$$

13) Wheel Force Function

Open Calculator

$$F_w = \frac{i \cdot i_o \cdot \tau_e}{2 \cdot r_w}$$

$$5.396825\text{N} = \frac{2.55 \cdot 2 \cdot 4\text{N*m}}{2 \cdot 1.89\text{m}}$$

Variables Used

- $\angle D$ Angle D *(Degree)*
- A_{ref} Reference Area *(Square Meter)*
- C_{drag} Drag Coefficient
- D Distance Travelled by Train *(Kilometer)*
- F_{drag} Drag Force *(Newton)*
- F_t Tractive Effort *(Newton)*
- F_w Wheel Force Function *(Newton)*
- G Gradient
- i Gear Ratio of Transmission
- i_o Gear Ratio of Final Drive
- N_{pp} Speed of Motor Shaft in Powerplant *(Revolution per Minute)*
- N_w Rotating Speed of Driven Wheels *(Revolution per Minute)*
- r_d Effective Radius of Wheel *(Meter)*
- r_w Radius of Wheel *(Meter)*
- T_{run} Running Time of Train *(Hour)*
- T_s Schedule Time *(Hour)*
- T_{stop} Stop Time of Train *(Minute)*
- t_α Time for Acceleration *(Second)*
- t_β Time for Retardation *(Second)*
- V_f Flow Velocity *(Kilometer per Hour)*
- V_m Crest Speed *(Kilometer per Hour)*

- V_s Schedule Speed *(Kilometer per Hour)*
- V_t Translational Speed *(Kilometer per Hour)*
- W Weight of Train *(Ton (Assay) (US))*
- W_e Accelerating Weight of Train *(Ton (Assay) (US))*
- α Acceleration of Train *(Kilometer per Hour Second)*
- β Retardation of Train *(Kilometer per Hour Second)*
- μ Coefficient of Adhesion
- ρ Mass Density *(Kilogram per Cubic Meter)*
- τ_e Engine Torque *(Newton Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- Measurement: **Length** in Kilometer (km), Meter (m)
  Length Unit Conversion
- Measurement: **Weight** in Ton (Assay) (US) (AT (US))
  Weight Unit Conversion
- Measurement: **Time** in Second (s), Hour (h), Minute (min)
  Time Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Speed** in Kilometer per Hour (km/h)
  Speed Unit Conversion
- Measurement: **Acceleration** in Kilometer per Hour Second (km/h*s)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Mass Concentration** in Kilogram per Cubic Meter (kg/m³)
  Mass Concentration Unit Conversion
- Measurement: **Angular Velocity** in Revolution per Minute (rev/min)
  Angular Velocity Unit Conversion

- Measurement: **Torque** in Newton Meter (N*m)
  Torque Unit Conversion

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