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High Load Factor Maneuver Formulas

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List of 17 High Load Factor Maneuver Formulas

High Load Factor Maneuver

1) Change in Angle of Attack due to Upward Gust

Open Calculator

fx $$\Delta\alpha = \tan\left(\frac{u}{V}\right)$$

ex $$0.239735\text{rad} = \tan\left(\frac{8\text{m/s}}{34\text{m/s}}\right)$$

2) Lift Coefficient for given Turn Radius

Open Calculator

fx $$C_L = \frac{W}{0.5 \cdot \rho_\infty \cdot S \cdot [g] \cdot R}$$

ex $$0.002 = \frac{1800\text{N}}{0.5 \cdot 1.225\text{kg/m}^3 \cdot 5.08\text{m}^2 \cdot [g] \cdot 29495.25\text{m}}$$

3) Lift Coefficient for given Turn Rate

Open Calculator

fx $$C_L = 2 \cdot W \cdot \frac{\omega^2}{[g]^2 \cdot \rho_\infty \cdot n \cdot S}$$

ex $$0.001998 = 2 \cdot 1800\text{N} \cdot \frac{(1.144\text{degree/s})^2}{[g]^2 \cdot 1.225\text{kg/m}^3 \cdot 1.2 \cdot 5.08\text{m}^2}$$

4) Lift Coefficient for given wing loading and turn radius

Open Calculator

fx $$C_L = 2 \cdot \frac{W_S}{\rho_\infty \cdot R \cdot [g]}$$

ex $$0.001998 = 2 \cdot \frac{354\text{Pa}}{1.225\text{kg/m}^3 \cdot 29495.25\text{m} \cdot [g]}$$

5) Load factor for given turn radius for high-performance fighter aircraft

Open Calculator

fx $$n = \frac{v^2}{[g] \cdot R}$$

ex $$1.199994 = \frac{(589.15\text{m/s})^2}{[g] \cdot 29495.25\text{m}}$$

6) Load factor for given turn rate for high-performance fighter aircraft

Open Calculator

fx $$n = v \cdot \frac{\omega}{[g]}$$

ex $$1.199523 = 589.15\text{m/s} \cdot \frac{1.144\text{degree/s}}{[g]}$$

7) Minimum Flight Velocity

Open Calculator

fx $$V_{min} = \sqrt{\left(\frac{W}{5}\right) \cdot \left(\frac{2}{\rho}\right) \cdot \left(\frac{1}{C_L}\right)}$$

ex $$589.9388\text{m/s} = \sqrt{\left(\frac{1800\text{N}}{4\text{m}^2}\right) \cdot \left(\frac{2}{1.293\text{kg/m}^3}\right) \cdot \left(\frac{1}{0.002}\right)}$$

8) Radius of Turn for given Lift Coefficient

Open Calculator

fx $$R = 2 \cdot \frac{W}{\rho_\infty \cdot S \cdot [g] \cdot C_L}$$

ex $$29495.25\text{m} = 2 \cdot \frac{1800\text{N}}{1.225\text{kg/m}^3 \cdot 5.08\text{m}^2 \cdot [g] \cdot 0.002}$$

9) Radius of Turn for given Wing Loading

Open Calculator

fx $$R = 2 \cdot \frac{W_S}{\rho_\infty \cdot C_L \cdot [g]}$$

ex $$29467.72\text{m} = 2 \cdot \frac{354\text{Pa}}{1.225\text{kg/m}^3 \cdot 0.002 \cdot [g]}$$

10) Turn radius for high load factor

Open Calculator

fx $$R = \frac{v^2}{[g] \cdot n}$$

ex $$29495.1\text{m} = \frac{(589.15\text{m/s})^2}{[g] \cdot 1.2}$$

11) Turn Rate for given Lift Coefficient

Open Calculator

fx $$\omega = [g] \cdot \left(\sqrt{\frac{S \cdot \rho_\infty \cdot C_L \cdot n}{2 \cdot W}} \right)$$

ex $$1.144452\text{degree/s} = [g] \cdot \left(\sqrt{\frac{5.08\text{m}^2 \cdot 1.225\text{kg/m}^3 \cdot 0.002 \cdot 1.2}{2 \cdot 1800\text{N}}} \right)$$

12) Turn Rate for given Wing Loading

Open Calculator

fx $$\omega = [g] \cdot \left(\sqrt{\rho_\infty \cdot C_L \cdot \frac{n}{2 \cdot W_S}} \right)$$

ex $$1.144986\text{degree/s} = [g] \cdot \left(\sqrt{1.225\text{kg/m}^3 \cdot 0.002 \cdot \frac{1.2}{2 \cdot 354\text{Pa}}} \right)$$

13) Turn Rate for High Load Factor

Open Calculator

$$\omega = [g] \cdot \frac{n}{v}$$

$$1.144455\text{degree/s} = [g] \cdot \frac{1.2}{589.15\text{m/s}}$$

14) Velocity for given pull-up maneuver rate

Open Calculator

$$V_{\text{pull-up}} = [g] \cdot \frac{n_{\text{pull-up}} - 1}{\omega}$$

$$240.1741\text{m/s} = [g] \cdot \frac{1.489 - 1}{1.144\text{degree/s}}$$

15) Velocity given Turn Radius for High Load Factor

Open Calculator

$$v = \sqrt{R \cdot n \cdot [g]}$$

$$589.1515\text{m/s} = \sqrt{29495.25\text{m} \cdot 1.2 \cdot [g]}$$

16) Wing Loading for given Turn Radius

Open Calculator

$$W_S = \frac{R \cdot \rho_\infty \cdot C_L \cdot [g]}{2}$$

$$354.3308\text{Pa} = \frac{29495.25\text{m} \cdot 1.225\text{kg/m}^3 \cdot 0.002 \cdot [g]}{2}$$

17) Wing Loading for given Turn Rate

Open Calculator

fx $$W_S = \left([g]^2\right) \cdot \rho_\infty \cdot C_L \cdot \frac{n}{2 \cdot \left(\omega^2\right)}$$

ex $$354.6108\text{Pa} = \left([g]^2\right) \cdot 1.225\text{kg/m}^3 \cdot 0.002 \cdot \frac{1.2}{2 \cdot \left((1.144\text{degree/s})^2\right)}$$

Variables Used

- **S** Aircraft Gross Wing Area *(Square Meter)*
- C_L Lift Coefficient
- **n** Load Factor
- $n_{pull-up}$ Pull-Up Load Factor
- **R** Turn Radius *(Meter)*
- **S** Reference Area *(Square Meter)*
- **u** Gust Velocity *(Meter per Second)*
- **v** Velocity *(Meter per Second)*
- **V** Flight Velocity *(Meter per Second)*
- V_{min} Minimum Flight Velocity *(Meter per Second)*
- $V_{pull-up}$ Pull-Up Maneuver Velocity *(Meter per Second)*
- **W** Aircraft Weight *(Newton)*
- W_S Wing Loading *(Pascal)*
- **Δα** Change in Angle of Attack *(Radian)*
- **ρ** Air Density *(Kilogram per Cubic Meter)*
- ρ_∞ Freestream Density *(Kilogram per Cubic Meter)*
- **ω** Turn Rate *(Degree per Second)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Function: **tan**, tan(Angle)
  The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Angular Velocity** in Degree per Second (degree/s)
  Angular Velocity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

Check other formula lists

- **High Load Factor Maneuver Formulas**

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