Important Aircraft Dynamics Nomenclature Formulas PDF

Formulas
Examples
with Units

List of 18
Important Aircraft Dynamics Nomenclature Formulas

1) Aerodynamic Axial Force Formula

Evaluate Formula

Formula

$$X = C_x \cdot q \cdot S$$

Example with Units

$$34.036\,\text{N} = 0.67 \cdot 10\,\text{Pa} \cdot 5.08\,\text{m}^2$$

2) Aerodynamic Normal Force Formula

Evaluate Formula

Formula

$$Z = C_z \cdot q \cdot S$$

Example with Units

$$19.304\,\text{N} = 0.38 \cdot 10\,\text{Pa} \cdot 5.08\,\text{m}^2$$

3) Aerodynamic Side Force Formula

Evaluate Formula

Formula

$$Y = C_y \cdot q \cdot S$$

Example with Units

$$38.608\,\text{N} = 0.76 \cdot 10\,\text{Pa} \cdot 5.08\,\text{m}^2$$

4) Angle of attack Formula

Evaluate Formula

Formula

$$\alpha = \operatorname{atan}\left(\frac{w}{u}\right)$$

Example with Units

$$1.3479^\circ = \operatorname{atan}\left(\frac{0.4\,\text{m/s}}{17\,\text{m/s}}\right)$$

5) Mean Aerodynamic Chord for Propeller-Driven Airplane Formula

Evaluate Formula

Formula

$$c_{ma} = \left(\frac{1}{S}\right) \cdot \int\left(L_c^{\,2}, x, -\frac{b}{2}, \frac{b}{2}\right)$$

Example with Units

$$142.126\,\text{m} = \left(\frac{1}{5.08\,\text{m}^2}\right) \cdot \int\left(3.8\,\text{m}^{\,2}, x, -\frac{50\,\text{m}}{2}, \frac{50\,\text{m}}{2}\right)$$

6) Normal Force Coefficient with Aerodynamic Normal Force Formula

Evaluate Formula

Formula

$$C_z = \frac{Z}{q \cdot S}$$

Example with Units

$$0.374 = \frac{19\,\text{N}}{10\,\text{Pa} \cdot 5.08\,\text{m}^2}$$

7) Pitching moment Formula

Evaluate Formula

Formula

$$M = C_m \cdot q \cdot S \cdot \ell$$

Example with Units

$$17.9832\,\text{N*m} = 0.59 \cdot 10\,\text{Pa} \cdot 5.08\,\text{m}^2 \cdot 0.6\,\text{m}$$

8) Pitching moment coefficient Formula

Evaluate Formula

Formula

$$C_m = \frac{M}{q \cdot S \cdot \ell}$$

Example with Units

$$0.5899 = \frac{17.98\,\text{N*m}}{10\,\text{Pa} \cdot 5.08\,\text{m}^2 \cdot 0.6\,\text{m}}$$

9) Rolling Moment Formula

Evaluate Formula

Formula

$$L = C_l \cdot q \cdot S \cdot \ell$$

Example with Units

$$18.5928\,\text{N*m} = 0.61 \cdot 10\,\text{Pa} \cdot 5.08\,\text{m}^2 \cdot 0.6\,\text{m}$$

10) Rolling moment coefficient Formula

Evaluate Formula

Formula

$$C_l = \frac{L}{q \cdot S \cdot \ell}$$

Example with Units

$$0.61 = \frac{18.5928\,\text{N*m}}{10\,\text{Pa} \cdot 5.08\,\text{m}^2 \cdot 0.6\,\text{m}}$$

11) Side force coefficient Formula

Evaluate Formula

Formula

$$C_y = \frac{Y}{q \cdot S}$$

Example with Units

$$0.748 = \frac{38\,\text{N}}{10\,\text{Pa} \cdot 5.08\,\text{m}^2}$$

12) Sideslip angle Formula

Evaluate Formula

Formula

$$\beta = asin\left(\frac{v}{\sqrt{\left(u^2\right) + \left(v^2\right) + \left(w^2\right)}}\right)$$

Example with Units

$$2.9624° = asin\left(\frac{0.88\,\text{m/s}}{\sqrt{\left(17\,\text{m/s}^2\right) + \left(0.88\,\text{m/s}^2\right) + \left(0.4\,\text{m/s}^2\right)}}\right)$$

13) Velocity along Pitch Axis for Small Sideslip Angle Formula

Evaluate Formula

Formula

$$v = \beta \cdot u$$

Example with Units

$$0.879\,\text{m/s} = 2.962436° \cdot 17\,\text{m/s}$$

14) Velocity along Roll Axis for Small Angle of Attack Formula

Evaluate Formula

Formula

$$u = \frac{w}{\alpha}$$

Example with Units

$$17.0032\,\text{m/s} = \frac{0.4\,\text{m/s}}{1.34788^\circ}$$

15) Velocity along Roll Axis for Small Sideslip Angle Formula

Evaluate Formula

Formula

$$u = \frac{v}{\beta}$$

Example with Units

$$17.0199\,\text{m/s} = \frac{0.88\,\text{m/s}}{2.962436^\circ}$$

16) Velocity along Yaw Axis for Small Angle of Attack Formula

Evaluate Formula

Formula

$$w = u \cdot \alpha$$

Example with Units

$$0.3999\,\text{m/s} = 17\,\text{m/s} \cdot 1.34788^\circ$$

17) Yawing Moment Formula

Evaluate Formula

Formula

$$N = C_n \cdot q \cdot S \cdot \ell$$

Example with Units

$$42.672\,\text{N*m} = 1.4 \cdot 10\,\text{Pa} \cdot 5.08\,\text{m}^2 \cdot 0.6\,\text{m}$$

18) Yawing moment coefficient Formula

Evaluate Formula

Formula

$$C_n = \frac{N}{q \cdot S \cdot \ell}$$

Example with Units

$$1.378 = \frac{42\,\text{N*m}}{10\,\text{Pa} \cdot 5.08\,\text{m}^2 \cdot 0.6\,\text{m}}$$

Variables used in list of Aircraft Dynamics Nomenclature Formulas above

- **b** Wingspan *(Meter)*
- C_m Pitching Moment Coefficient
- c_{ma} Mean Aerodynamic Chord *(Meter)*
- C_n Yawing Moment Coefficient
- C_x Axial Force Coefficient
- C_y Side Force Coefficient
- C_z Normal Force Coefficient
- C_l Rolling Moment Coefficient
- L_c Chord Length *(Meter)*
- **q** Dynamic Pressure *(Pascal)*
- **S** Reference Area *(Square Meter)*
- **u** Velocity Along Roll Axis *(Meter per Second)*
- **v** Velocity Along Pitch Axis *(Meter per Second)*
- **w** Velocity Along Yaw Axis *(Meter per Second)*
- **X** Aerodynamic Axial Force *(Newton)*
- **Y** Aerodynamic Side Force *(Newton)*
- **Z** Aerodynamic Normal Force *(Newton)*
- **α** Angle of Attack *(Degree)*
- **β** Sideslip Angle *(Degree)*
- L Rolling Moment *(Newton Meter)*
- M Pitching Moment *(Newton Meter)*
- N Yawing Moment *(Newton Meter)*
- ℓ Characteristic Length *(Meter)*

Constants, Functions, Measurements used in list of Aircraft Dynamics Nomenclature Formulas above

- Functions: **asin**, asin(Number)
  The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.
- Functions: **atan**, atan(Number)
  Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.
- Functions: **int**, int(expr, arg, from, to)
  The definite integral can be used to calculate net signed area, which is the area above the x -axis minus the area below the x -axis.
- Functions: **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.
- Functions: **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.
- Functions: **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 Degree (°)
  Angle Unit Conversion

- Measurement: **Moment of Force** in Newton Meter (N*m)
  Moment of Force Unit Conversion

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