Important Wing-Tail Interaction Formulas PDF

Formulas
Examples
with Units

List of 12
Important Wing-Tail Interaction Formulas

1) Dynamic Pressure at Vertical Tail for given Vertical Tail Efficiency Formula

Evaluate Formula

Formula

$$Q_v = \eta_v \cdot Q_w$$

Example with Units

$$10.9956\,\text{Pa} = 16.66 \cdot 0.66\,\text{Pa}$$

2) Dynamic Pressure at Vertical Tail for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

$$Q_v = C_n \cdot S \cdot b \cdot \frac{Q_w}{l_v \cdot S_v \cdot C_v \cdot (\beta + \sigma)}$$

Example with Units

$$10.985\,\text{Pa} = 1.4 \cdot 5.08\,\text{m}^2 \cdot 1.15\,\text{m} \cdot \frac{0.66\,\text{Pa}}{1.2\,\text{m} \cdot 5\,\text{m}^2 \cdot 0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad})}$$

3) Dynamic Pressure at Wing for given Vertical Tail Efficiency Formula

Evaluate Formula

Formula

$$Q_w = \frac{Q_v}{\eta_v}$$

Example with Units

$$0.6603\,\text{Pa} = \frac{11\,\text{Pa}}{16.66}$$

4) Dynamic Pressure at Wing for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

$$Q_w = l_v \cdot S_v \cdot Q_v \cdot C_v \cdot \frac{\beta + \sigma}{S \cdot b \cdot C_n}$$

Example with Units

$$0.6609\,\text{Pa} = 1.2\,\text{m} \cdot 5\,\text{m}^2 \cdot 11\,\text{Pa} \cdot 0.7\,\text{rad}^{-1} \cdot \frac{0.05\,\text{rad} + 0.067\,\text{rad}}{5.08\,\text{m}^2 \cdot 1.15\,\text{m} \cdot 1.4}$$

5) Vertical Tail Dynamic Pressure for given Moment Formula

Evaluate Formula

Formula

$$Q_v = \frac{N_v}{l_v \cdot C_v \cdot (\beta + \sigma) \cdot S_v}$$

Example with Units

$$10.989\,\text{Pa} = \frac{5.4\,\text{N*m}}{1.2\,\text{m} \cdot 0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad}) \cdot 5\,\text{m}^2}$$

6) Wing Area for given Moment Produced by Vertical Tail Formula

Evaluate Formula

Formula

$$S = \frac{N_v}{C_n \cdot Q_w \cdot b}$$

Example with Units

$$5.0819\,\text{m}^2 = \frac{5.4\,\text{N*m}}{1.4 \cdot 0.66\,\text{Pa} \cdot 1.15\,\text{m}}$$

7) Wing Area for given Vertical Tail Volume Ratio Formula

Evaluate Formula

Formula

$$S = l_v \cdot \frac{S_v}{b \cdot V_v}$$

Example with Units

$$5.1151\,\text{m}^2 = 1.2\,\text{m} \cdot \frac{5\,\text{m}^2}{1.15\,\text{m} \cdot 1.02}$$

8) Wing Area for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

$$S = l_v \cdot S_v \cdot Q_v \cdot C_v \cdot \frac{\beta + \sigma}{C_n \cdot b \cdot Q_w}$$

Example with Units

$$5.087\,\text{m}^2 = 1.2\,\text{m} \cdot 5\,\text{m}^2 \cdot 11\,\text{Pa} \cdot 0.7\,\text{rad}^{-1} \cdot \frac{0.05\,\text{rad} + 0.067\,\text{rad}}{1.4 \cdot 1.15\,\text{m} \cdot 0.66\,\text{Pa}}$$

9) Wing Dynamic Pressure for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

$$Q_w = \frac{N_v}{C_n \cdot S \cdot b}$$

Example with Units

$$0.6602\,\text{Pa} = \frac{5.4\,\text{N*m}}{1.4 \cdot 5.08\,\text{m}^2 \cdot 1.15\,\text{m}}$$

10) Wingspan for given Vertical Tail Volume Ratio Formula

Evaluate Formula

Formula

$$b = l_v \cdot \frac{S_v}{S \cdot V_v}$$

Example with Units

$$1.1579\,\text{m} = 1.2\,\text{m} \cdot \frac{5\,\text{m}^2}{5.08\,\text{m}^2 \cdot 1.02}$$

11) Wingspan for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

$$b = \frac{N_v}{C_n \cdot S \cdot Q_w}$$

Example with Units

$$1.1504\,\text{m} = \frac{5.4\,\text{N*m}}{1.4 \cdot 5.08\,\text{m}^2 \cdot 0.66\,\text{Pa}}$$

12) Wingspan for Yawing Moment Coefficient given Sideslip Angle and Sidewash Angle Formula

Evaluate Formula

Formula

$$b = l_v \cdot S_v \cdot Q_v \cdot C_v \cdot \frac{\beta + \sigma}{S \cdot C_n \cdot Q_w}$$

Example with Units

$$1.1516\,\text{m} = 1.2\,\text{m} \cdot 5\,\text{m}^2 \cdot 11\,\text{Pa} \cdot 0.7\,\text{rad}^{-1} \cdot \frac{0.05\,\text{rad} + 0.067\,\text{rad}}{5.08\,\text{m}^2 \cdot 1.4 \cdot 0.66\,\text{Pa}}$$

Variables used in list of Wing-Tail Interaction Formulas above

- **b** Wingspan *(Meter)*
- C_n Yawing Moment Coefficient
- C_v Vertical Tail Lift Curve Slope *(1 per Radian)*
- N_v Vertical Tail Moment *(Newton Meter)*
- Q_v Vertical Tail Dynamic Pressure *(Pascal)*
- Q_w Wing Dynamic Pressure *(Pascal)*
- **S** Reference Area *(Square Meter)*
- S_v Vertical Tail Area *(Square Meter)*
- V_v Vertical Tail Volume Ratio
- **β** Sideslip Angle *(Radian)*
- η_v Vertical Tail Efficiency
- **σ** Sidewash Angle *(Radian)*
- l_v Vertical Tail Moment Arm *(Meter)*

Constants, Functions, Measurements used in list of Wing-Tail Interaction Formulas above

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Moment of Force** in Newton Meter (N*m)
  Moment of Force Unit Conversion
- Measurement: **Reciprocal Angle** in 1 per Radian (rad^{-1})
  Reciprocal Angle Unit Conversion

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