Important Vertical Tail Contribution Formulas PDF

Formulas
Examples
with Units

List of 24
Important Vertical Tail Contribution Formulas

1) Moment Produced by Vertical Tail for given Lift Curve Slope Formula

Evaluate Formula

Formula

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

Example with Units

$$5.4054\,\text{N*m} = 1.2\,\text{m} \cdot 0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad}) \cdot 11\,\text{Pa} \cdot 5\,\text{m}^2$$

2) Moment Produced by Vertical Tail for given Moment Coefficient Formula

Evaluate Formula

Formula

$$N_v = C_n \cdot Q_w \cdot b \cdot S$$

Example with Units

$$5.398\,\text{N*m} = 1.4 \cdot 0.66\,\text{Pa} \cdot 1.15\,\text{m} \cdot 5.08\,\text{m}^2$$

3) Moment Produced by Vertical Tail for given Side Force Formula

Evaluate Formula

Formula

$$N_v = -\left(l_v \cdot Y_v \right)$$

Example with Units

$$5.082\,\text{N*m} = -\left(1.2\,\text{m} \cdot -4.235\,\text{N} \right)$$

4) Vertical Tail Angle of Attack Formula

Evaluate Formula

Formula

$$\alpha_v = \sigma + \beta$$

Example with Units

$$0.117\,\text{rad} = 0.067\,\text{rad} + 0.05\,\text{rad}$$

5) Vertical Tail Angle of Attack for given Vertical Tail Side Force Formula

Evaluate Formula

Formula

$$\alpha_v = -\left(\frac{Y_v}{C_v \cdot Q_v \cdot S_v} \right)$$

Example with Units

$$0.11\,\text{rad} = -\left(\frac{-4.235\,\text{N}}{0.7\,\text{rad}^{-1} \cdot 11\,\text{Pa} \cdot 5\,\text{m}^2} \right)$$

6) Vertical Tail Area for given Moment Formula

Evaluate Formula

Formula

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

Example with Units

$$4.995\,\text{m}^2 = \frac{5.4\,\text{N*m}}{1.2\,\text{m} \cdot 0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad}) \cdot 11\,\text{Pa}}$$

7) Vertical Tail Area for given Vertical Tail Side Force Formula

Evaluate Formula

Formula

$$S_v = -\frac{Y_v}{C_v \cdot \alpha_v \cdot Q_v}$$

Example with Units

$$4.7009\,\text{m}^2 = -\frac{-4.235\,\text{N}}{0.7\,\text{rad}^{-1} \cdot 0.117\,\text{rad} \cdot 11\,\text{Pa}}$$

8) Vertical tail area for given vertical tail volume ratio Formula

Evaluate Formula

Formula

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

Example with Units

$$4.9657\,\text{m}^2 = 1.02 \cdot 5.08\,\text{m}^2 \cdot \frac{1.15\,\text{m}}{1.2\,\text{m}}$$

9) Vertical Tail Area for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

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

Example with Units

$$4.9932\,\text{m}^2 = 1.4 \cdot \frac{5.08\,\text{m}^2 \cdot 1.15\,\text{m} \cdot 0.66\,\text{Pa}}{1.2\,\text{m} \cdot 11\,\text{Pa} \cdot 0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad})}$$

10) Vertical Tail Dynamic Pressure for given Vertical Tail Side Force Formula

Evaluate Formula

Formula

$$Q_v = -\left(\frac{Y_v}{C_v \cdot \alpha_v \cdot S_v}\right)$$

Example with Units

$$10.3419\,\text{Pa} = -\left(\frac{-4.235\,\text{N}}{0.7\,\text{rad}^{-1} \cdot 0.117\,\text{rad} \cdot 5\,\text{m}^2}\right)$$

11) Vertical Tail Efficiency Formula

Evaluate Formula

Formula

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

Example with Units

$$16.6667 = \frac{11\,\text{Pa}}{0.66\,\text{Pa}}$$

12) Vertical Tail Efficiency for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

$$\eta_v = \frac{C_n}{V_v \cdot C_v \cdot (\beta + \sigma)}$$

Example with Units

$$16.7588 = \frac{1.4}{1.02 \cdot 0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad})}$$

13) Vertical Tail Lift Curve Slope Formula

Evaluate Formula

Formula

$$C_v = -\left(\frac{Y_v}{\alpha_v \cdot Q_v \cdot S_v}\right)$$

Example with Units

$$0.6581\,\text{rad}^{-1} = -\left(\frac{-4.235\,\text{N}}{0.117\,\text{rad} \cdot 11\,\text{Pa} \cdot 5\,\text{m}^2}\right)$$

14) Vertical Tail Lift Curve Slope for Given Moment Formula

Evaluate Formula

Formula

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

Example with Units

$$0.6993\,\text{rad}^{-1} = \frac{5.4\,\text{N*m}}{1.2\,\text{m} \cdot (0.05\,\text{rad} + 0.067\,\text{rad}) \cdot 11\,\text{Pa} \cdot 5\,\text{m}^2}$$

15) Vertical Tail Lift Curve Slope for given Vertical Tail Efficiency Formula

Evaluate Formula

Formula

$$C_v = \frac{C_n}{V_v \cdot \eta_v \cdot (\beta + \sigma)}$$

Example with Units

$$0.7042\,\text{rad}^{-1} = \frac{1.4}{1.02 \cdot 16.66 \cdot (0.05\,\text{rad} + 0.067\,\text{rad})}$$

16) Vertical Tail Lift Curve Slope for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

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

Example with Units

$$0.699\,\text{rad}^{-1} = 1.4 \cdot 5.08\,\text{m}^2 \cdot 1.15\,\text{m} \cdot \frac{0.66\,\text{Pa}}{1.2\,\text{m} \cdot 5\,\text{m}^2 \cdot 11\,\text{Pa} \cdot (0.05\,\text{rad} + 0.067\,\text{rad})}$$

17) Vertical Tail Moment Arm for given Lift Curve Slope Formula

Evaluate Formula

Formula

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

Example with Units

$$1.1988\,\text{m} = \frac{5.4\,\text{N*m}}{0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad}) \cdot 11\,\text{Pa} \cdot 5\,\text{m}^2}$$

18) Vertical Tail Moment Arm for given Side Force Formula

Evaluate Formula

Formula

$$l_v = -\frac{N_v}{Y_v}$$

Example with Units

$$1.2751\,\text{m} = -\frac{5.4\,\text{N*m}}{-4.235\,\text{N}}$$

19) Vertical Tail Moment Arm for given Vertical Tail Volume Ratio Formula

Evaluate Formula

Formula

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

Example with Units

$$1.1918\,\text{m} = 1.02 \cdot 5.08\,\text{m}^2 \cdot \frac{1.15\,\text{m}}{5\,\text{m}^2}$$

20) Vertical Tail Moment Arm for Given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

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

Example with Units

$$1.1984\,\text{m} = \frac{1.4}{5\,\text{m}^2 \cdot 11\,\text{Pa} \cdot 0.7\,\text{rad}^{-1} \cdot \frac{0.05\,\text{rad} + 0.067\,\text{rad}}{5.08\,\text{m}^2 \cdot 1.15\,\text{m} \cdot 0.66\,\text{Pa}}}$$

21) Vertical Tail Side Force Formula

Evaluate Formula

Formula

$$Y_v = -C_v \cdot \alpha_v \cdot S_v \cdot Q_v$$

Example with Units

$$-4.5045\,\text{N} = -0.7\,\text{rad}^{-1} \cdot 0.117\,\text{rad} \cdot 5\,\text{m}^2 \cdot 11\,\text{Pa}$$

22) Vertical Tail Side Force for Given Moment Formula

Evaluate Formula

Formula

$$Y_v = -\left(\frac{N_v}{l_v}\right)$$

Example with Units

$$-4.5\,\text{N} = -\left(\frac{5.4\,\text{N*m}}{1.2\,\text{m}}\right)$$

23) Vertical tail volume ratio Formula

Evaluate Formula

Formula

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

Example with Units

$$1.027 = 1.2\,\text{m} \cdot \frac{5\,\text{m}^2}{5.08\,\text{m}^2 \cdot 1.15\,\text{m}}$$

24) Vertical Tail Volume Ratio for given Yawing Moment Coefficient Formula

Evaluate Formula

Formula

$$V_v = \frac{C_n}{\eta_v \cdot C_v \cdot (\beta + \sigma)}$$

Example with Units

$$1.0261 = \frac{1.4}{16.66 \cdot 0.7\,\text{rad}^{-1} \cdot (0.05\,\text{rad} + 0.067\,\text{rad})}$$

Variables used in list of Vertical Tail Contribution 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
- Y_v Vertical Tail Side Force *(Newton)*
- α_v Vertical Tail Angle of Attack *(Radian)*
- 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 Vertical Tail Contribution 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: **Force** in Newton (N)
  Force 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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