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Vertical Tail Contribution Formulas

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List of 24 Vertical Tail Contribution Formulas

Vertical Tail Contribution

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

$$fx \quad N_v = l_v \cdot C_v \cdot (\beta + \sigma) \cdot Q_w \cdot S_v$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

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

2) Moment Produced by Vertical Tail for given Moment Coefficient

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

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$ex \quad 5.398008N*m = 1.4 \cdot 0.66Pa \cdot 1.15m \cdot 5.08m^2$$

3) Moment Produced by Vertical Tail for given Side Force

$$fx \quad N_v = -(l_v \cdot Y_v)$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$ex \quad 5.082N*m = -(1.2m \cdot -4.235N)$$

4) Vertical Tail Angle of Attack

$$fx \quad \alpha_v = \sigma + \beta$$

[Open Calculator !\[\]\(83bbbd261710c59db0214aa27b2edc0d_img.jpg\)](#)

$$ex \quad 0.117rad = 0.067rad + 0.05rad$$



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

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

Open Calculator 


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

6) Vertical Tail Area for given Moment 

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

Open Calculator 

$$ex \quad 4.995005 \text{m}^2 = \frac{5.4 \text{N} \cdot \text{m}}{1.2 \text{m} \cdot 0.7 \text{rad}^{-1} \cdot (0.05 \text{rad} + 0.067 \text{rad}) \cdot 11 \text{Pa}}$$

7) Vertical Tail Area for given Vertical Tail Side Force 

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

Open Calculator 

$$ex \quad 4.700855 \text{m}^2 = - \frac{-4.235 \text{N}}{0.7 \text{rad}^{-1} \cdot 0.117 \text{rad} \cdot 11 \text{Pa}}$$

8) Vertical tail area for given vertical tail volume ratio 

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

Open Calculator 

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




9) Vertical Tail Area for given Yawing Moment Coefficient 

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

Open Calculator 

$$ex \quad 4.993162m^2 = 1.4 \cdot \frac{5.08m^2 \cdot 1.15m \cdot 0.66Pa}{1.2m \cdot 11Pa \cdot 0.7rad^{-1} \cdot (0.05rad + 0.067rad)}$$

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

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

Open Calculator 

$$ex \quad 10.34188Pa = - \left(\frac{-4.235N}{0.7rad^{-1} \cdot 0.117rad \cdot 5m^2} \right)$$

11) Vertical Tail Efficiency 

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

Open Calculator 

$$ex \quad 16.66667 = \frac{11Pa}{0.66Pa}$$

12) Vertical Tail Efficiency for given Yawing Moment Coefficient 

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

Open Calculator 

$$ex \quad 16.75884 = \frac{1.4}{1.02 \cdot 0.7rad^{-1} \cdot (0.05rad + 0.067rad)}$$




13) Vertical Tail Lift Curve Slope 

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

Open Calculator 

$$\text{ex } 0.65812\text{rad}^{-1} = - \left(\frac{-4.235\text{N}}{0.117\text{rad} \cdot 11\text{Pa} \cdot 5\text{m}^2} \right)$$

14) Vertical Tail Lift Curve Slope for Given Moment 

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

Open Calculator 


$$\text{ex } 0.699301\text{rad}^{-1} = \frac{5.4\text{N}^*\text{m}}{1.2\text{m} \cdot (0.05\text{rad} + 0.067\text{rad}) \cdot 11\text{Pa} \cdot 5\text{m}^2}$$

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

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

Open Calculator 

$$\text{ex } 0.704153\text{rad}^{-1} = \frac{1.4}{1.02 \cdot 16.66 \cdot (0.05\text{rad} + 0.067\text{rad})}$$


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

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

Open Calculator 

$$\text{ex } 0.699043\text{rad}^{-1} = 1.4 \cdot 5.08\text{m}^2 \cdot 1.15\text{m} \cdot \frac{0.66\text{Pa}}{1.2\text{m} \cdot 5\text{m}^2 \cdot 11\text{Pa} \cdot (0.05\text{rad} + 0.067\text{rad})}$$



17) Vertical Tail Moment Arm for given Lift Curve Slope 

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

Open Calculator 


$$ex \quad 1.198801m = \frac{5.4N^*m}{0.7rad^{-1} \cdot (0.05rad + 0.067rad) \cdot 11Pa \cdot 5m^2}$$

18) Vertical Tail Moment Arm for given Side Force 

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

Open Calculator 

$$ex \quad 1.275089m = -\frac{5.4N^*m}{-4.235N}$$

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

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

Open Calculator 

$$ex \quad 1.191768m = 1.02 \cdot 5.08m^2 \cdot \frac{1.15m}{5m^2}$$


20) Vertical Tail Moment Arm for Given Yawing Moment Coefficient 

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

Open Calculator 

$$ex \quad 1.198359m = \frac{1.4}{5m^2 \cdot 11Pa \cdot 0.7rad^{-1} \cdot \frac{0.05rad + 0.067rad}{5.08m^2 \cdot 1.15m \cdot 0.66Pa}}$$



21) Vertical Tail Side Force 

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

Open Calculator 


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

22) Vertical Tail Side Force for Given Moment 

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

Open Calculator 


$$ex \quad -4.5N = -\left(\frac{5.4N^*m}{1.2m}\right)$$

23) Vertical tail volume ratio 

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

Open Calculator 

$$ex \quad 1.027046 = 1.2m \cdot \frac{5m^2}{5.08m^2 \cdot 1.15m}$$

24) Vertical Tail Volume Ratio for given Yawing Moment Coefficient 

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

Open Calculator 

$$ex \quad 1.026051 = \frac{1.4}{16.66 \cdot 0.7rad^{-1} \cdot (0.05rad + 0.067rad)}$$










Variables Used

- **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

- **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: 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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- [Aerodynamic Parameters Formulas](#) 
- [Vertical Tail Contribution Formulas](#) 
- [Wing-Tail Interaction Formulas](#) 

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