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Elliptical Lift Distribution Formulas

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List of 20 Elliptical Lift Distribution Formulas

Elliptical Lift Distribution

1) Aspect Ratio given Induced Angle of Attack

Open Calculator

fx $$\mathrm{AR_{ELD}} = \frac{\mathrm{C_{L,ELD}}}{\pi \cdot \alpha_i}$$

ex $$2.470395 = \frac{1.49}{\pi \cdot 11^\circ}$$

2) Aspect Ratio given Induced Drag Coefficient

Open Calculator

fx $$\mathrm{AR_{ELD}} = \frac{\mathrm{C_{L,ELD}^2}}{\pi \cdot \mathrm{C_{D,i,ELD}}}$$

ex $$2.453749 = \frac{(1.49)^2}{\pi \cdot 0.288}$$

3) Circulation at given Distance along Wingspan

Open Calculator

fx $$\Gamma = \Gamma_o \cdot \sqrt{1 - \left(2 \cdot \frac{a}{b}\right)^2}$$

ex $$13.99862\mathrm{m^2/s} = 14\mathrm{m^2/s} \cdot \sqrt{1 - \left(2 \cdot \frac{16.4\mathrm{mm}}{2340\mathrm{mm}}\right)^2}$$

4) Circulation at Origin given Downwash

Open Calculator

fx $\Gamma_o = -2 \cdot w \cdot b$

ex $14.04\text{m}^2/\text{s} = -2 \cdot \text{-3m/s} \cdot 2340\text{mm}$

5) Circulation at Origin given Induced Angle of Attack

Open Calculator

fx $\Gamma_o = 2 \cdot b \cdot \alpha_i \cdot V_\infty$

ex $13.92668\text{m}^2/\text{s} = 2 \cdot 2340\text{mm} \cdot 11^\circ \cdot 15.5\text{m/s}$

6) Circulation at Origin given Lift of Wing

Open Calculator

fx $\Gamma_o = 4 \cdot \frac{F_L}{\rho_\infty \cdot V_\infty \cdot b \cdot \pi}$

ex $14.0074\text{m}^2/\text{s} = 4 \cdot \frac{488.8\text{N}}{1.225\text{kg/m}^3 \cdot 15.5\text{m/s} \cdot 2340\text{mm} \cdot \pi}$

7) Circulation at Origin in Elliptical Lift Distribution

Open Calculator

fx $\Gamma_o = 2 \cdot V_\infty \cdot S_0 \cdot \frac{C_l}{\pi \cdot b}$

ex $13.97911\text{m}^2/\text{s} = 2 \cdot 15.5\text{m/s} \cdot 2.21\text{m}^2 \cdot \frac{1.5}{\pi \cdot 2340\text{mm}}$

8) Coefficient of Lift given Circulation at Origin

Open Calculator

fx $$C_{L,ELD} = \pi \cdot b \cdot \frac{\Gamma_o}{2 \cdot V_\infty \cdot S_0}$$

ex $$1.502242 = \pi \cdot 2340\text{mm} \cdot \frac{14\text{m}^2/\text{s}}{2 \cdot 15.5\text{m/s} \cdot 2.21\text{m}^2}$$

9) Coefficient of Lift given Induced Angle of Attack

Open Calculator

fx $$C_{L,ELD} = \pi \cdot \alpha_i \cdot AR_{ELD}$$

ex $$1.495793 = \pi \cdot 11^\circ \cdot 2.48$$

10) Coefficient of Lift given Induced Drag Coefficient

Open Calculator

fx $$C_{L,ELD} = \sqrt{\pi \cdot AR_{ELD} \cdot C_{D,i,ELD}}$$

ex $$1.497949 = \sqrt{\pi \cdot 2.48 \cdot 0.288}$$

11) Downwash in Elliptical Lift Distribution

Open Calculator

fx $$w = -\frac{\Gamma_o}{2 \cdot b}$$

ex $$-2.991453\text{m/s} = -\frac{14\text{m}^2/\text{s}}{2 \cdot 2340\text{mm}}$$

12) Freestream Velocity given Circulation at Origin

Open Calculator

fx $$V_\infty = \pi \cdot b \cdot \frac{\Gamma_o}{2 \cdot S_0 \cdot C_{L,ELD}}$$

ex $$15.62735\text{m/s} = \pi \cdot 2340\text{mm} \cdot \frac{14\text{m}^2\text{/s}}{2 \cdot 2.21\text{m}^2 \cdot 1.49}$$

13) Freestream Velocity given Induced Angle of Attack

Open Calculator

fx $$V_\infty = \frac{\Gamma_o}{2 \cdot b \cdot \alpha_i}$$

ex $$15.5816\text{m/s} = \frac{14\text{m}^2\text{/s}}{2 \cdot 2340\text{mm} \cdot 11^\circ}$$

14) Induced Angle of Attack given Aspect Ratio

Open Calculator

fx $$\alpha_i = \frac{C_l}{\pi \cdot AR_{ELD}}$$

ex $$11.03094^\circ = \frac{1.5}{\pi \cdot 2.48}$$

15) Induced Angle of Attack given Circulation at Origin

Open Calculator

fx $$\alpha_i = \frac{\Gamma_o}{2 \cdot b \cdot V_\infty}$$

ex $$11.05791^\circ = \frac{14\text{m}^2\text{/s}}{2 \cdot 2340\text{mm} \cdot 15.5\text{m/s}}$$

16) Induced Angle of Attack given Coefficient of Lift

Open Calculator

fx $$\alpha_i = S_0 \cdot \frac{C_l}{\pi \cdot b^2}$$

ex $$11.04141^\circ = 2.21\text{m}^2 \cdot \frac{1.5}{\pi \cdot (2340\text{mm})^2}$$

17) Induced Angle of Attack given Downwash

Open Calculator

fx $$\alpha_i = -\left(\frac{w}{V_\infty}\right)$$

ex $$11.08951^\circ = -\left(\frac{-3\text{m/s}}{15.5\text{m/s}}\right)$$

18) Induced Drag Coefficient given Aspect Ratio

Open Calculator

fx $$C_{D,i,ELD} = \frac{C_{L,ELD}^2}{\pi \cdot AR_{ELD}}$$

ex $$0.284952 = \frac{(1.49)^2}{\pi \cdot 2.48}$$

19) Lift at given Distance along Wingspan

Open Calculator

fx $$L = \rho_{\infty} \cdot V_{\infty} \cdot \Gamma_{o} \cdot \sqrt{1 - \left(2 \cdot \frac{a}{b}\right)^2}$$

ex $$265.7989\text{N} = 1.225\text{kg/m}^3 \cdot 15.5\text{m/s} \cdot 14\text{m}^2\text{/s} \cdot \sqrt{1 - \left(2 \cdot \frac{16.4\text{mm}}{2340\text{mm}}\right)^2}$$

20) Lift of Wing given Circulation at Origin

Open Calculator

fx $$F_L = \frac{\pi \cdot \rho_{\infty} \cdot V_{\infty} \cdot b \cdot \Gamma_{o}}{4}$$

ex $$488.5416\text{N} = \frac{\pi \cdot 1.225\text{kg/m}^3 \cdot 15.5\text{m/s} \cdot 2340\text{mm} \cdot 14\text{m}^2\text{/s}}{4}$$

Variables Used

- **a** Distance from Center to Point *(Millimeter)*
- **AR_{ELD}** Wing Aspect Ratio ELD
- **b** Wingspan *(Millimeter)*
- **$C_{D,i,ELD}$** Induced Drag Coefficient ELD
- **C_l** Lift Coefficient Origin
- **$C_{L,ELD}$** Lift Coefficient ELD
- **F_L** Lift Force *(Newton)*
- **L** Lift at Distance *(Newton)*
- **S_0** Reference Area Origin *(Square Meter)*
- **V_∞** Freestream Velocity *(Meter per Second)*
- **w** Downwash *(Meter per Second)*
- **α_i** Induced Angle of Attack *(Degree)*
- **Γ** Circulation *(Square Meter per Second)*
- **Γ_o** Circulation at Origin *(Square Meter per Second)*
- **ρ_∞** Freestream Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area 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: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Momentum Diffusivity** in Square Meter per Second (m²/s)
  Momentum Diffusivity Unit Conversion

Check other formula lists

- **Elliptical Lift Distribution Formulas**

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