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Lifting Flow over Cylinder Formulas

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List of 10 Lifting Flow over Cylinder Formulas

Lifting Flow over Cylinder

1) 2-D Lift Coefficient for Cylinder

Open Calculator

fx $$C_L = \frac{\Gamma}{R \cdot V_\infty}$$

ex $$1.268116 = \frac{0.7\text{m}^2/\text{s}}{0.08\text{m} \cdot 6.9\text{m/s}}$$

2) Angular Position given Radial Velocity for Lifting Flow over Circular Cylinder

Open Calculator

fx $$\theta = \arccos\left(\frac{V_r}{\left(1 - \left(\frac{R}{r}\right)^2\right) \cdot V_\infty}\right)$$

ex $$0.902545\text{rad} = \arccos\left(\frac{3.9\text{m/s}}{\left(1 - \left(\frac{0.08\text{m}}{0.27\text{m}}\right)^2\right) \cdot 6.9\text{m/s}}\right)$$

3) Angular Position of Stagnation Point for Lifting Flow over Circular Cylinder

Open Calculator

fx $$\theta_0 = ar\sin\left(-\frac{\Gamma_0}{4 \cdot \pi \cdot V_{s,\infty} \cdot R}\right)$$

ex $$-1.055971\text{rad} = ar\sin\left(-\frac{7\text{m}^2/\text{s}}{4 \cdot \pi \cdot 8\text{m/s} \cdot 0.08\text{m}}\right)$$

4) Freestream Velocity given 2-D Lift Coefficient for Lifting Flow

Open Calculator

fx $$V_\infty = \frac{\Gamma}{R \cdot C_L}$$

ex $$7.291667\text{m/s} = \frac{0.7\text{m}^2/\text{s}}{0.08\text{m} \cdot 1.2}$$

5) Location of Stagnation Point Outside Cylinder for Lifting Flow

Open Calculator

fx $$r_0 = \frac{\Gamma_0}{4 \cdot \pi \cdot V_\infty} + \sqrt{\left(\frac{\Gamma_0}{4 \cdot \pi \cdot V_\infty}\right)^2 - R^2}$$

ex $$0.091569\text{m} = \frac{7\text{m}^2/\text{s}}{4 \cdot \pi \cdot 6.9\text{m/s}} + \sqrt{\left(\frac{7\text{m}^2/\text{s}}{4 \cdot \pi \cdot 6.9\text{m/s}}\right)^2 - (0.08\text{m})^2}$$

6) Radial Velocity for Lifting Flow over Circular Cylinder

Open Calculator

fx $$V_r = \left(1 - \left(\frac{R}{r}\right)^2\right) \cdot V_\infty \cdot \cos(\theta)$$

ex $$3.912562\text{m/s} = \left(1 - \left(\frac{0.08\text{m}}{0.27\text{m}}\right)^2\right) \cdot 6.9\text{m/s} \cdot \cos(0.9\text{rad})$$

7) Radius of Cylinder for Lifting Flow

Open Calculator

fx $$R = \frac{\Gamma}{C_L \cdot V_\infty}$$

ex $$0.084541\text{m} = \frac{0.7\text{m}^2/\text{s}}{1.2 \cdot 6.9\text{m/s}}$$

8) Stream Function for Lifting Flow over Circular Cylinder

Open Calculator

fx $$\psi = V_\infty \cdot r \cdot \sin(\theta) \cdot \left(1 - \left(\frac{R}{r}\right)^2\right) + \frac{\Gamma}{2 \cdot \pi} \cdot \ln\left(\frac{r}{R}\right)$$

ex $$1.466737\text{m}^2/\text{s} = 6.9\text{m/s} \cdot 0.27\text{m} \cdot \sin(0.9\text{rad}) \cdot \left(1 - \left(\frac{0.08\text{m}}{0.27\text{m}}\right)^2\right) + \frac{0.7\text{m}^2/\text{s}}{2 \cdot \pi} \cdot \ln\left(\frac{0.27\text{m}}{0.08\text{m}}\right)$$

9) Surface Pressure Coefficient for Lifting Flow over Circular Cylinder

Open Calculator

fx $$C_p = 1 - \left((2 \cdot \sin(\theta))^2 + \frac{2 \cdot \Gamma \cdot \sin(\theta)}{\pi \cdot R \cdot V_\infty} + \left(\frac{\Gamma}{2 \cdot \pi \cdot R \cdot V_\infty} \right)^2 \right)$$

ex $$-2.127524 = 1 - \left((2 \cdot \sin(0.9\text{rad}))^2 + \frac{2 \cdot 0.7\text{m}^2/\text{s} \cdot \sin(0.9\text{rad})}{\pi \cdot 0.08\text{m} \cdot 6.9\text{m/s}} + \left(\frac{0.7\text{m}^2/\text{s}}{2 \cdot \pi \cdot 0.08\text{m} \cdot 6.9\text{m/s}} \right)^2 \right)$$

10) Tangential Velocity for Lifting Flow over Circular Cylinder

Open Calculator

fx $$V_\theta = -\left(1 + \left(\frac{R}{r} \right)^2 \right) \cdot V_\infty \cdot \sin(\theta) - \frac{\Gamma}{2 \cdot \pi \cdot r}$$

ex $$-6.292089\text{m/s} = -\left(1 + \left(\frac{0.08\text{m}}{0.27\text{m}} \right)^2 \right) \cdot 6.9\text{m/s} \cdot \sin(0.9\text{rad}) - \frac{0.7\text{m}^2/\text{s}}{2 \cdot \pi \cdot 0.27\text{m}}$$

Variables Used

- C_L Lift Coefficient
- C_p Surface Pressure Coefficient
- r Radial Coordinate *(Meter)*
- R Cylinder Radius *(Meter)*
- r_0 Radial Coordinate of Stagnation Point *(Meter)*
- V_∞ Freestream Velocity *(Meter per Second)*
- V_r Radial Velocity *(Meter per Second)*
- $V_{s,\infty}$ Stagnation Freestream Velocity *(Meter per Second)*
- V_θ Tangential Velocity *(Meter per Second)*
- Γ Vortex Strength *(Square Meter per Second)*
- Γ_0 Stagnation Vortex Strength *(Square Meter per Second)*
- θ Polar Angle *(Radian)*
- θ_0 Polar Angle of Stagnation Point *(Radian)*
- ψ Stream Function *(Square Meter per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **arccos**, arccos(Number)
  Inverse trigonometric cosine function
- Function: **arsin**, arsin(Number)
  Inverse trigonometric sine function
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **ln**, ln(Number)
  Natural logarithm function (base e)
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Velocity Potential** in Square Meter per Second (m²/s)
  Velocity Potential Unit Conversion

Check other formula lists

- **Lifting Flow over Cylinder Formulas**
- **Nonlifting Flow over Cylinder Formulas**

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