Important Lifting Flow over Cylinder Formulas PDF

Formulas
Examples
with Units

List of 10
Important Lifting Flow over Cylinder Formulas

1) 2-D Lift Coefficient for Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

$$1.2681 = \frac{0.7\,\text{m}^2/\text{s}}{0.08\,\text{m} \cdot 6.9\,\text{m/s}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$0.9025\,\text{rad} = \arccos\left(\frac{3.9\,\text{m/s}}{\left(1 - \left(\frac{0.08\,\text{m}}{0.27\,\text{m}}\right)^2\right) \cdot 6.9\,\text{m/s}}\right)$$

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

Evaluate Formula

Formula

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

Example with Units

$$-1.056\,\text{rad} = arsin\left(-\frac{7\,\text{m}^2/\text{s}}{4 \cdot 3.1416 \cdot 8\,\text{m/s} \cdot 0.08\,\text{m}}\right)$$

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

Evaluate Formula

Formula

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

Example with Units

$$7.2917\,\text{m/s} = \frac{0.7\,\text{m}^2/\text{s}}{0.08\,\text{m} \cdot 1.2}$$

5) Location of Stagnation Point Outside Cylinder for Lifting Flow Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0916\,\text{m} = \frac{7\,\text{m}^2/\text{s}}{4 \cdot 3.1416 \cdot 6.9\,\text{m/s}} + \sqrt{\left(\frac{7\,\text{m}^2/\text{s}}{4 \cdot 3.1416 \cdot 6.9\,\text{m/s}}\right)^2 - 0.08\,\text{m}^2}$$

6) Radial Velocity for Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

$$3.9126\,\text{m/s} = \left(1 - \left(\frac{0.08\,\text{m}}{0.27\,\text{m}}\right)^2\right) \cdot 6.9\,\text{m/s} \cdot \cos(0.9\,\text{rad})$$

7) Radius of Cylinder for Lifting Flow Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0845\,\text{m} = \frac{0.7\,\text{m}^2/\text{s}}{1.2 \cdot 6.9\,\text{m/s}}$$

8) Stream Function for Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

$$1.4667\,\text{m}^2/\text{s} = 6.9\,\text{m/s} \cdot 0.27\,\text{m} \cdot \sin(0.9\,\text{rad}) \cdot \left(1 - \left(\frac{0.08\,\text{m}}{0.27\,\text{m}}\right)^2\right) + \frac{0.7\,\text{m}^2/\text{s}}{2 \cdot 3.1416} \cdot \ln\left(\frac{0.27\,\text{m}}{0.08\,\text{m}}\right)$$

9) Surface Pressure Coefficient for Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

$$-2.1275 = 1 - \left(\left(2 \cdot \sin\left(0.9\,\text{rad} \right) \right)^2 + \frac{2 \cdot 0.7\,\text{m}^2/\text{s} \cdot \sin\left(0.9\,\text{rad} \right)}{3.1416 \cdot 0.08\,\text{m} \cdot 6.9\,\text{m/s}} + \left(\frac{0.7\,\text{m}^2/\text{s}}{2 \cdot 3.1416 \cdot 0.08\,\text{m} \cdot 6.9\,\text{m/s}} \right)^2 \right)$$

10) Tangential Velocity for Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

$$-6.2921\,\text{m/s} = -\left(1 + \left(\frac{0.08\,\text{m}}{0.27\,\text{m}} \right)^2 \right) \cdot 6.9\,\text{m/s} \cdot \sin\left(0.9\,\text{rad} \right) - \frac{0.7\,\text{m}^2/\text{s}}{2 \cdot 3.1416 \cdot 0.27\,\text{m}}$$

Variables used in list of Lifting Flow over Cylinder Formulas above

- 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 in list of Lifting Flow over Cylinder Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **arccos**, arccos(Number) *Arccosine function, is the inverse function of the cosine function.It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.*
- Functions: **arsin**, arsin(Number) *Arcsine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.*
- Functions: **cos**, cos(Angle) *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **ln**, ln(Number) *The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- 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*

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