Important Nonlifting Flow over Cylinder Formulas PDF

Formulas
Examples
with Units

List of 10
Important Nonlifting Flow over Cylinder Formulas

1) Angular Position given Pressure Coefficient for Non-Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

$$\theta = arsin\left(\frac{\sqrt{1 - \left(C_p\right)}}{2}\right)$$

Example with Units

$$1.0835\,\text{rad} = arsin\left(\frac{\sqrt{1 - \left(-2.123\right)}}{2}\right)$$

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

Evaluate Formula

Formula

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

Example with Units

$$0.9936\,\text{rad} = -arsin\left(\frac{-6.29\,\text{m/s}}{\left(1 + \frac{0.08\,\text{m}^2}{0.27\,\text{m}^2}\right) \cdot 6.9\,\text{m/s}}\right)$$

4) Doublet Strength given Radius of Cylinder for Non-Lifting Flow Formula

Evaluate Formula

Formula

$$\kappa = R^2 \cdot 2 \cdot \pi \cdot V_\infty$$

Example with Units

$$0.2775\,\text{m}^3\text{/s} = 0.08\,\text{m}^2 \cdot 2 \cdot 3.1416 \cdot 6.9\,\text{m/s}$$

5) Freestream Velocity given Doublet Strength for Non-Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

$$V_\infty = \frac{\kappa}{R^2 \cdot 2 \cdot \pi}$$

Example with Units

$$5.471\,\text{m/s} = \frac{0.22\,\text{m}^3/\text{s}}{0.08\,\text{m}^2 \cdot 2 \cdot 3.1416}$$

6) Radial Velocity for Non-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 Non-Lifting Flow Formula

Evaluate Formula

Formula

$$R = \sqrt{\frac{\kappa}{2 \cdot \pi \cdot V_\infty}}$$

Example with Units

$$0.0712\,\text{m} = \sqrt{\frac{0.22\,\text{m}^3/\text{s}}{2 \cdot 3.1416 \cdot 6.9\,\text{m/s}}}$$

8) Stream Function for Non-Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

$$1.3312\,\text{m}^2/\text{s} = 6.9\,\text{m/s} \cdot 0.27\,\text{m} \cdot \sin(0.9\,\text{rad}) \cdot \left(1 - \left(\frac{0.08\,\text{m}}{0.27\,\text{m}}\right)^2\right)$$

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

Evaluate Formula

Formula

$$C_p = 1 - 4 \cdot (\sin(\theta))^2$$

Example with Units

$$-1.4544 = 1 - 4 \cdot (\sin(0.9\,\text{rad}))^2$$

10) Tangential Velocity for Non-Lifting Flow over Circular Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

$$-5.8795\,\text{m/s} = -\left(1+\left(\frac{0.08\,\text{m}}{0.27\,\text{m}}\right)^2\right)\cdot 6.9\,\text{m/s}\cdot \sin(0.9\,\text{rad})$$

Variables used in list of Nonlifting Flow over Cylinder Formulas above

- C_p Surface Pressure Coefficient
- **r** Radial Coordinate *(Meter)*
- **R** Cylinder Radius *(Meter)*
- V_∞ Freestream Velocity *(Meter per Second)*
- V_r Radial Velocity *(Meter per Second)*
- V_θ Tangential Velocity *(Meter per Second)*
- **θ** Polar Angle *(Radian)*
- **κ** Doublet Strength *(Cubic Meter per Second)*
- **ψ** Stream Function *(Square Meter per Second)*

Constants, Functions, Measurements used in list of Nonlifting 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: **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: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s) *Volumetric Flow Rate Unit Conversion*
- Measurement: **Velocity Potential** in Square Meter per Second (m²/s) *Velocity Potential Unit Conversion*

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