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Force Exerted by Fluid Jet on Moving Curved Vane Formulas

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List of 21 Force Exerted by Fluid Jet on Moving Curved Vane Formulas

Force Exerted by Fluid Jet on Moving Curved Vane

Jet Striking a Symmetrical Moving Curved Vane at Centre

1) Absolute Velocity for Force Exerted by Jet in Direction of Flow of Incoming Jet

Open Calculator

fx $$V_{absolute} = \left(\frac{\sqrt{F \cdot G}}{\gamma_f \cdot A_{Jet} \cdot (1 + \cos(\theta))}\right) + v$$

ex $$9.917616\text{m/s} = \left(\frac{\sqrt{2.5\text{N} \cdot 10}}{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot (1 + \cos(30^\circ))}\right) + 9.69\text{m/s}$$

2) Absolute Velocity for Mass of Fluid Striking Vane per Second

Open Calculator

fx $$V_{absolute} = \left(\frac{m_f \cdot G}{\gamma_f \cdot A_{Jet}}\right) + v$$

ex $$10.45453\text{m/s} = \left(\frac{0.9\text{kg} \cdot 10}{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2}\right) + 9.69\text{m/s}$$

3) Efficiency of Jet

Open Calculator

fx $$\eta = \left((2 \cdot v) \cdot (V_{absolute} - v)^2 \cdot (1 + \cos(\theta))\right) \cdot \frac{100}{V_{absolute}^3}$$

ex $$0.590031 = \left((2 \cdot 9.69\text{m/s}) \cdot (10.1\text{m/s} - 9.69\text{m/s})^2 \cdot (1 + \cos(30^\circ))\right) \cdot \frac{100}{(10.1\text{m/s})^3}$$

4) Kinetic Energy of Jet per Second

Open Calculator

$$KE = \frac{A_{Jet} \cdot v_{jet}^3}{2}$$

$$1036.8\text{J} = \frac{1.2\text{m}^2 \cdot (12\text{m/s})^3}{2}$$

5) Mass of Fluid Striking Vane per Seconds

Open Calculator

$$m_f = \frac{\gamma_f \cdot A_{Jet} \cdot (V_{absolute} - v)}{G}$$

$$0.482652\text{kg} = \frac{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot (10.1\text{m/s} - 9.69\text{m/s})}{10}$$

6) Maximum Efficiency

Open Calculator

$$\eta_{max} = \left(\frac{1}{2}\right) \cdot (1 + \cos(\theta))$$

$$0.933013 = \left(\frac{1}{2}\right) \cdot (1 + \cos(30^\circ))$$

7) Velocity of Vane for given Mass of Fluid

Open Calculator

$$v = V_{absolute} - \left(\frac{m_f \cdot G}{\gamma_f \cdot A_{Jet}}\right)$$

$$9.335474\text{m/s} = 10.1\text{m/s} - \left(\frac{0.9\text{kg} \cdot 10}{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2}\right)$$

8) Velocity of Vane given Exerted Force by Jet

Open Calculator

fx $$v = -\left(\sqrt{\frac{F \cdot G}{\gamma_f \cdot A_{Jet} \cdot (1+\cos(\theta))}} - V_{absolute}\right)$$

ex $$9.033192\text{m/s} = -\left(\sqrt{\frac{2.5\text{N} \cdot 10}{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot (1+\cos(30^\circ))}} - 10.1\text{m/s}\right)$$

9) Work Done by Jet on Vane per Second

Open Calculator

fx $$w = \left(\frac{\gamma_f \cdot A_{Jet} \cdot (V_{absolute} - v)^2}{G}\right) \cdot (1+\cos(\theta)) \cdot v$$

ex $$3.578156\text{KJ} = \left(\frac{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot (10.1\text{m/s} - 9.69\text{m/s})^2}{10}\right) \cdot (1+\cos(30^\circ)) \cdot 9.69\text{m/s}$$

10) Work Done per Second given Efficiency of Wheel

Open Calculator

fx $$w = \eta \cdot KE$$

ex $$0.009608\text{KJ} = 0.80 \cdot 12.01\text{J}$$

Area of Cross Section

11) Area of Cross Section for Force Exerted by Jet in Direction of Flow

Open Calculator

fx $$A_{Jet} = \frac{F \cdot G}{(1+\cos(\theta)) \cdot \gamma_f \cdot V_{absolute} \cdot (V_{absolute} - v)}$$

ex $$0.329798\text{m}^2 = \frac{2.5\text{N} \cdot 10}{(1+\cos(30^\circ)) \cdot 9.81\text{kN/m}^3 \cdot 10.1\text{m/s} \cdot (10.1\text{m/s} - 9.69\text{m/s})}$$

12) Area of Cross Section for Force Exerted by Jet with relative velocity

Open Calculator

fx $$A_{Jet} = \frac{F \cdot G}{(1 + a \cdot \cos(\theta)) \cdot \gamma_f \cdot V_{absolute} \cdot (V_{absolute} - v)}$$

ex $$0.328275\text{m}^2 = \frac{2.5\text{N} \cdot 10}{(1 + 1.01 \cdot \cos(30^\circ)) \cdot 9.81\text{kN/m}^3 \cdot 10.1\text{m/s} \cdot (10.1\text{m/s} - 9.69\text{m/s})}$$

13) Area of Cross Section for Mass of Fluid Striking moving Vane per Second

Open Calculator

fx $$A_{Jet} = \frac{m_f \cdot G}{\gamma_f \cdot (V_{absolute} - v)}$$

ex $$2.237637\text{m}^2 = \frac{0.9\text{kg} \cdot 10}{9.81\text{kN/m}^3 \cdot (10.1\text{m/s} - 9.69\text{m/s})}$$

14) Area of Cross Section for work done by Jet on vane per second

Open Calculator

fx $$A_{Jet} = \frac{w \cdot G}{\gamma_f \cdot (V_{absolute} - v)^2 \cdot (1 + \cos(\theta)) \cdot v}$$

ex $$1.307936\text{m}^2 = \frac{3.9\text{KJ} \cdot 10}{9.81\text{kN/m}^3 \cdot (10.1\text{m/s} - 9.69\text{m/s})^2 \cdot (1 + \cos(30^\circ)) \cdot 9.69\text{m/s}}$$

Force Exerted by Jet

15) Force Exerted by Jet in Direction of Flow of Incoming Jet with angle at 90

Open Calculator

fx $$Ft = \left(\frac{\gamma_f \cdot A_{Jet} \cdot (V_{absolute} - v)^2}{G} \right)$$

ex $$0.197887\text{kN} = \left(\frac{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot (10.1\text{m/s} - 9.69\text{m/s})^2}{10} \right)$$

16) Force Exerted by Jet in Direction of Flow of Incoming Jet with angle zero

Open Calculator

fx $$Ft = \left(\frac{\gamma_f \cdot A_{Jet} \cdot (V_{absolute} - v)^2}{G} \right)$$

ex $$0.197887\text{kN} = \left(\frac{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot (10.1\text{m/s} - 9.69\text{m/s})^2}{10} \right)$$

17) Force Exerted by Jet in direction of Flow of Jet

Open Calculator

fx $$F_s = \left(\frac{\gamma_f \cdot A_{Jet} \cdot V_{absolute} \cdot (V_{absolute} - v)}{G} \right) \cdot (1 + \cos(\theta))$$

ex $$9.096473\text{N} = \left(\frac{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot 10.1\text{m/s} \cdot (10.1\text{m/s} - 9.69\text{m/s})}{10} \right) \cdot (1 + \cos(30^\circ))$$

18) Force Exerted by jet with relative velocity

Open Calculator

fx $$F_s = \left(\frac{\gamma_f \cdot A_{Jet} \cdot V_{absolute} \cdot (V_{absolute} - v)}{G} \right) \cdot (1 + a \cdot \cos(\theta))$$

ex $$9.13869\text{N} = \left(\frac{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot 10.1\text{m/s} \cdot (10.1\text{m/s} - 9.69\text{m/s})}{10} \right) \cdot (1 + 1.01 \cdot \cos(30^\circ))$$

Jet Striking an Unsymmetrical Moving Curved Vane Tangentially at one of the Tips

19) Area of Cross Section for Mass of Fluid Striking Vane per Second

Open Calculator

fx $$A_{Jet} = \frac{m_f \cdot G}{\gamma_f \cdot v}$$

ex $$0.094678\text{m}^2 = \frac{0.9\text{kg} \cdot 10}{9.81\text{kN/m}^3 \cdot 9.69\text{m/s}}$$

20) Mass of Fluid Striking Vanes per Second

Open Calculator

$$m_f = \frac{\gamma_f \cdot A_{Jet} \cdot v}{G}$$

$$11.40707\text{kg} = \frac{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot 9.69\text{m/s}}{10}$$

21) Velocity at Inlet for Mass of Fluid Striking Vane per Second

Open Calculator

$$v = \frac{m_f \cdot G}{\gamma_f \cdot A_{Jet}}$$

$$0.764526\text{m/s} = \frac{0.9\text{kg} \cdot 10}{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2}$$

Variables Used

- **a** Numerical Coefficient a
- **A_{Jet}** Cross Sectional Area of Jet *(Square Meter)*
- **F** Force exerted by Jet *(Newton)*
- **F_s** Force by Stationary Plate *(Newton)*
- **Ft** Thrust Force *(Kilonewton)*
- **G** Specific Gravity of Fluid
- **KE** Kinetic Energy *(Joule)*
- **m_f** Fluid Mass *(Kilogram)*
- **v** Velocity of Jet *(Meter per Second)*
- **$V_{absolute}$** Absolute Velocity of Issuing Jet *(Meter per Second)*
- **v_{jet}** Fluid Jet Velocity *(Meter per Second)*
- **w** Work Done *(Kilojoule)*
- **γ_f** Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- **η** Efficiency of Jet
- **η_{max}** Maximum Efficiency
- **θ** Theta *(Degree)*

Constants, Functions, Measurements used

- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Joule (J), Kilojoule (KJ)
  Energy Unit Conversion
- Measurement: **Force** in Newton (N), Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion

Check other formula lists

- **Force Exerted by Fluid Jet on Moving Curved Vane Formulas**

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