Important Force Exerted by Fluid Jet on Stationary Flat Plate Formulas PDF

Formulas
Examples
with Units

List of 22
Important Force Exerted by Fluid Jet on Stationary Flat Plate Formulas

1) Flat Plate Inclined at an Angle to the Jet Formulas

1.1) Cross Sectional Area of Jet for given Dynamic Thrust Normal to Direction of Jet Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{F_Y \cdot [g]}{\gamma_f \cdot v_{jet}^2 \cdot \sin(\angle D) \cdot \cos(\angle D)}$$

Example with Units

$$1.4084\,\text{m}^2 = \frac{38\,\text{kN} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 12\,\text{m/s}^2 \cdot \sin(11°) \cdot \cos(11°)}$$

1.2) Cross Sectional Area of Jet for given Dynamic Thrust Parallel to Direction of Jet Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{F_X \cdot [g]}{\gamma_f \cdot v_{jet}^2 \cdot (\sin(\angle D))^2}$$

Example with Units

$$1.9449\,\text{m}^2 = \frac{10.2\,\text{kN} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 12\,\text{m/s}^2 \cdot (\sin(11°))^2}$$

1.3) Cross Sectional Area of Jet for given Thrust Exerted in Direction of Normal to Plate Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{F_p \cdot [g]}{\gamma_f \cdot v_{jet}^2 \cdot (\sin(\angle D))}$$

Example with Units

$$1.4189\,\text{m}^2 = \frac{39\,\text{kN} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 12\,\text{m/s}^2 \cdot (\sin(11°))}$$

1.4) Discharge Flowing by Jet Formula

Evaluate Formula

Formula

$$Q = Q_{x,y} + Q_{x,y}$$

Example with Units

$$1.02\,\text{m}^3/\text{s} = 0.51\,\text{m}^3/\text{s} + 0.51\,\text{m}^3/\text{s}$$

1.5) Discharge Flowing in Direction Normal to Plate Formula

Evaluate Formula

Formula

$$Q_{x,y} = \left(\frac{Q}{2}\right) \cdot \left(1 + \cos\left(\angle D\right)\right)$$

Example with Units

$$1.0007\,\text{m}^3/\text{s} = \left(\frac{1.01\,\text{m}^3/\text{s}}{2}\right) \cdot \left(1 + \cos\left(11^\circ\right)\right)$$

1.6) Discharge Flowing in Direction Parallel to Plate Formula

Evaluate Formula

Formula

$$Q_{x,y} = \left(\frac{Q}{2}\right) \cdot \left(1 - \cos\left(\angle D\right)\right)$$

Example with Units

$$0.0093\,\text{m}^3/\text{s} = \left(\frac{1.01\,\text{m}^3/\text{s}}{2}\right) \cdot \left(1 - \cos\left(11^\circ\right)\right)$$

1.7) Force Exerted by Jet in Direction Normal to Plate Formula

Evaluate Formula

Formula

$$F_p = \left(\frac{\gamma_f \cdot A_{Jet} \cdot \left(v_{jet}^2\right)}{[g]}\right) \cdot \sin\left(\angle D\right)$$

Example with Units

$$32.9831\,\text{kN} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(12\,\text{m/s}^2\right)}{9.8066\,\text{m/s}^2}\right) \cdot \sin\left(11^\circ\right)$$

1.8) Force Exerted by Jet Normal to Direction of Jet Normal to Plate Formula

Evaluate Formula

Formula

$$F_Y = \left(\frac{\gamma_f \cdot A_{Jet} \cdot v_{jet}^2}{[g]}\right) \cdot \sin\left(\angle D\right) \cdot \cos\left(\angle D\right)$$

Example with Units

$$32.3771\,\text{kN} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot 12\,\text{m/s}^2}{9.8066\,\text{m/s}^2}\right) \cdot \sin\left(11^\circ\right) \cdot \cos\left(11^\circ\right)$$

1.9) Force Exerted by Jet Parallel to Direction of Jet Normal to Plate Formula

Evaluate Formula

Formula

$$F_X = \left(\frac{\gamma_f \cdot A_{Jet} \cdot v_{jet}^2}{[g]}\right) \cdot \left(\sin\left(\angle D\right)\right)^2$$

Example with Units

$$6.2935\,\text{kN} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot 12\,\text{m/s}^2}{9.8066\,\text{m/s}^2}\right) \cdot \left(\sin\left(11^\circ\right)\right)^2$$

1.10) Velocity of Fluid given Thrust Exerted Normal to Plate Formula

Evaluate Formula

Formula

$$v_{jet} = \sqrt{\frac{F_p \cdot [g]}{\gamma_f \cdot A_{Jet} \cdot \left(\sin\left(\angle D\right)\right)}}$$

Example with Units

$$13.0487\,\text{m/s} = \sqrt{\frac{39\,\text{kN} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(\sin\left(11^\circ\right)\right)}}$$

1.11) Velocity of Fluid given Thrust Normal to Jet Formula

Evaluate Formula

Formula

$$v_{jet} = \sqrt{\frac{F_Y \cdot [g]}{\gamma_f \cdot A_{Jet} \cdot \left(\sin\left(\angle D\right)\right) \cdot \cos\left(\angle D\right)}}$$

Example with Units

$$13.0003\,\text{m/s} = \sqrt{\frac{38\,\text{kN} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(\sin\left(11^\circ\right)\right) \cdot \cos\left(11^\circ\right)}}$$

1.12) Velocity of Fluid given Thrust Parallel to Jet Formula

Evaluate Formula

Formula

$$v_{jet} = \sqrt{\frac{F_X \cdot [g]}{\gamma_f \cdot A_{Jet} \cdot \left(\sin\left(\angle D\right)\right)^2}}$$

Example with Units

$$15.2769\,\text{m/s} = \sqrt{\frac{10.2\,\text{kN} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(\sin\left(11^\circ\right)\right)^2}}$$

2) Flat Plate Normal to the Jet Formulas

2.1) Area of Cross Section of Jet for Force Exerted by Stationary Plate on Jet Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{F_{St,\perp p} \cdot [g]}{\gamma_f \cdot v_{jet}^2}$$

Example with Units

$$1.201\,\text{m}^2 = \frac{173\,\text{N} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 12\,\text{m/s}^2}$$

2.2) Area of Cross Section of Jet given Mass of Fluid Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{m_{pS} \cdot [g]}{\gamma_f \cdot v_{jet}}$$

Example with Units

$$1.1996\,\text{m}^2 = \frac{14.4\,\text{kg/s} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 12\,\text{m/s}}$$

2.3) Force Exerted by Stationary Plate on Jet Formula

Evaluate Formula

Formula

$$F_{St,\perp p} = \frac{\gamma_f \cdot A_{Jet} \cdot \left(v_{jet}^2\right)}{[g]}$$

Example with Units

$$172.859\,\text{N} = \frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(12\,\text{m/s}^2\right)}{9.8066\,\text{m/s}^2}$$

2.4) Mass Flow Rate of Fluid Striking Plate Formula

Evaluate Formula

Formula

$$m_{pS} = \frac{\gamma_f \cdot A_{Jet} \cdot v_{jet}}{[g]}$$

Example with Units

$$14.4049\,\text{kg/s} = \frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot 12\,\text{m/s}}{9.8066\,\text{m/s}^2}$$

2.5) Velocity for Force Exerted by Stationary Plate on Jet Formula

Evaluate Formula

Formula

$$v_{jet} = \sqrt{\frac{F_{St,\perp p} \cdot [g]}{\gamma_f \cdot A_{Jet}}}$$

Example with Units

$$12.0049\,\text{m/s} = \sqrt{\frac{173\,\text{N} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2}}$$

2.6) Velocity given Mass of Fluid Formula

Evaluate Formula

Formula

$$v_{jet} = \frac{m_{pS} \cdot [g]}{\gamma_f \cdot A_{Jet}}$$

Example with Units

$$11.9959\,\text{m/s} = \frac{14.4\,\text{kg/s} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2}$$

3) Jet Striking a Symmetrical Stationary Curved Vane at the Centre Formulas

3.1) Cross Sectional Area for Force Exerted on Plate in Direction of Flow of Jet Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{F_{jet} \cdot [g]}{\gamma_f \cdot v_{jet}^2 \cdot \left(1 + \cos\left(\theta_t\right)\right)}$$

Example with Units

$$1.1962\,\text{m}^2 = \frac{320\,\text{N} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 12\,\text{m/s}^2 \cdot \left(1 + \cos\left(31°\right)\right)}$$

3.2) Force Exerted on Plate in Direction of Flow of Jet on Stationary Curved Vane Formula

Evaluate Formula

Formula

$$F_{jet} = \left(\frac{\gamma_f \cdot A_{Jet} \cdot v_{jet}^2}{[g]}\right) \cdot \left(1 + \cos\left(\theta_t\right)\right)$$

Example with Units

$$321.0281\,\text{N} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot 12\,\text{m/s}^2}{9.8066\,\text{m/s}^2}\right) \cdot \left(1 + \cos\left(31°\right)\right)$$

3.3) Force Exerted on Plate in Direction of Flow of Jet when Theta is Zero Formula

Evaluate Formula

Formula

$$F_{jet} = \frac{2 \cdot \gamma_f \cdot A_{Jet} \cdot v_{jet}^2}{[g]}$$

Example with Units

$$345.7181\,\text{N} = \frac{2 \cdot 9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot 12\,\text{m/s}^2}{9.8066\,\text{m/s}^2}$$

3.4) Velocity for Force Exerted on Plate in Direction of Flow of Jet Formula

Evaluate Formula

Formula

$$v_{jet} = \sqrt{\frac{F_{jet} \cdot [g]}{\gamma_f \cdot A_{Jet} \cdot \left(1 + \cos\left(\theta_t\right)\right)}}$$

Example with Units

$$11.9808\,\text{m/s} = \sqrt{\frac{320\,\text{N} \cdot 9.8066\,\text{m/s}^2}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(1 + \cos\left(31°\right)\right)}}$$

Variables used in list of Force Exerted by Fluid Jet on Stationary Flat Plate Formulas above

- $\angle D$ Angle between Jet and Plate *(Degree)*
- A_{Jet} Cross Sectional Area of Jet *(Square Meter)*
- F_{jet} Force on Plate in Dir of Jet on Stat Curved Vane *(Newton)*
- F_p Force Exerted by Jet Normal to Plate *(Kilonewton)*
- $F_{St,\perp p}$ Force by Stationary Plate on Jet ⊥ Plate *(Newton)*
- F_X Force by Jet Normal to Plate in X *(Kilonewton)*
- F_Y Force by Jet Normal to Plate in Y *(Kilonewton)*
- m_{pS} Mass Flow Rate of Jet *(Kilogram per Second)*
- Q Discharge by Jet *(Cubic Meter per Second)*
- $Q_{x,y}$ Discharge in any Direction *(Cubic Meter per Second)*
- v_{jet} Fluid Jet Velocity *(Meter per Second)*
- γ_f Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- θ_t Half of Angle Between Two Tangent to Vane *(Degree)*

Constants, Functions, Measurements used in list of Force Exerted by Fluid Jet on Stationary Flat Plate Formulas above

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Kilonewton (kN), Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Mass Flow Rate** in Kilogram per Second (kg/s)
  Mass Flow Rate Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion

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