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# Force Exerted by Fluid Jet on Moving Flat Plate Formulas 

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## List of 23 Force Exerted by Fluid Jet on Moving Flat Plate Formulas

## Force Exerted by Fluid Jet on Moving Flat Plate ©

Flat Plate Inclined at an Angle to the Jet

1) Dynamic Thrust Exerted by Jet on Plate
$f \mathrm{Fx}=\left(\frac{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\mathrm{Jet}} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)^{2}}{\mathrm{G}}\right) \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right)$
$\operatorname{ex} 2.176761 \mathrm{kN}=\left(\frac{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2}}{10}\right) \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right)$
2) Normal Thrust Normal to Direction of Jet
fX

$$
\mathrm{Ft}=\left(\frac{\gamma_{\mathrm{f}} \cdot \mathrm{~A}_{\text {Jet }} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)^{2}}{\mathrm{G}}\right) \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right) \cdot \cos (\theta)
$$

$1.88513 \mathrm{kN}=\left(\frac{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2}}{10}\right) \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right) \cdot \cos \left(30^{\circ}\right)$
3) Normal Thrust Parallel to Direction of Jet
$f \mathbf{x} \mathrm{Ft}=\left(\frac{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\mathrm{Jet}} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)^{2}}{\mathrm{G}}\right) \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right)$
ex $2.176761 \mathrm{kN}=\left(\frac{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2}}{10}\right) \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right)$

## Absolute Velocity

4) Absolute velocity for dynamic thrust exerted by jet on plate
$\mathrm{fx}_{\mathrm{x}} \mathrm{V}_{\text {absolute }}=\left(\sqrt{\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\mathrm{Jet}} \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right)}}\right)+\mathrm{v}$
$\operatorname{ex} 9.698337 \mathrm{~m} / \mathrm{s}=\left(\sqrt{\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right)}}\right)+9.69 \mathrm{~m} / \mathrm{s}$
5) Absolute Velocity for given Normal Thrust Normal to Direction of Jet
$\mathrm{fx} \mathrm{V}_{\text {absolute }}=\left(\sqrt{\frac{\mathrm{Ft} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\mathrm{Jet}} \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right) \cdot \cos (\theta)}}\right)+\mathrm{v}$
ex $16.36726 \mathrm{~m} / \mathrm{s}=\left(\sqrt{\frac{0.5 \mathrm{kN} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right) \cdot \cos \left(30^{\circ}\right)}}\right)+9.69 \mathrm{~m} / \mathrm{s}$
6) Absolute Velocity for given Normal Thrust Parallel to Direction of Jet
$f \times V_{\text {absolute }}=\sqrt{\frac{\mathrm{Ft} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\mathrm{Jet}} \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right)^{2}}}+\mathrm{v}$
Open Calculator
ex $9.749247 \mathrm{~m} / \mathrm{s}=\sqrt{\frac{0.5 \mathrm{kN} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right)^{2}}}+9.69 \mathrm{~m} / \mathrm{s}$
7) Absolute Velocity for Mass of Fluid Striking Plate
$f \mathbf{x} \mathrm{~V}_{\text {absolute }}=\left(\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\text {Jet }}}\right)+\mathrm{v}$
ex $9.690765 \mathrm{~m} / \mathrm{s}=\left(\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2}}\right)+9.69 \mathrm{~m} / \mathrm{s}$

## Cross Sectional Area

8) Cross Section Area for Mass of Fluid Striking Plate
$\mathrm{f}_{\mathrm{x}} \mathrm{A}_{\text {Jet }}=\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)}$
ex $2.237637 \mathrm{~m}^{2}=\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})}$
9) Cross Sectional Area for given Dynamic Thrust Exerted by Jet on Plate
$f \mathbf{x} \mathrm{~A}_{\mathrm{Jet}}=\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right) \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}_{\mathrm{jet}}\right)^{2}}$
Open Calculator
ex $0.023103 \mathrm{~m}^{2}=\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right) \cdot(10.1 \mathrm{~m} / \mathrm{s}-12 \mathrm{~m} / \mathrm{s})^{2}}$
10) Cross Sectional Area for given Normal Thrust Normal to Direction of Jet $\longleftarrow$


Open Calculator
ex $0.31828 \mathrm{~m}^{2}=\frac{0.5 \mathrm{kN} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right) \cdot \cos \left(30^{\circ}\right)}$
11) Cross Sectional Area for given Work Done by Jet per Second
$f x \mathrm{~A}_{\text {Jet }}=\frac{\mathrm{Ft} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}_{\text {jet }}\right)^{2} \cdot \mathrm{~V}_{\mathrm{j}} \cdot \angle \mathrm{D}^{2}}$
$\boldsymbol{e x} 0.425609 \mathrm{~m}^{2}=\frac{0.5 \mathrm{kN} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot(10.1 \mathrm{~m} / \mathrm{s}-12 \mathrm{~m} / \mathrm{s})^{2} \cdot 9 \mathrm{~m} / \mathrm{s} \cdot\left(11^{\circ}\right)^{2}}$

## Velocity of Jet

12) Velocity of jet for dynamic thrust exerted by jet on plate
$f \mathrm{x}=\mathrm{v}=-\left(\sqrt{\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\mathrm{Jet}} \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right)}}-\mathrm{V}_{\text {absolute }}\right)$
$\mathrm{ex} 10.09166 \mathrm{~m} / \mathrm{s}=-\left(\sqrt{\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right)}}-10.1 \mathrm{~m} / \mathrm{s}\right)$
13) Velocity of Jet given Normal Thrust Normal to Direction of Jet
$\mathrm{fx} \mathrm{v}=-\left(\sqrt{\frac{\mathrm{Ft} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\text {Jet }} \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right) \cdot \cos (\theta)}}\right)+\mathrm{V}_{\text {absolute }}$
Open Calculator ©
ex $9.888847 \mathrm{~m} / \mathrm{s}=-\left(\sqrt{\frac{0.5 \mathrm{kN} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right) \cdot \cos \left(30^{\circ}\right)}}\right)+10.1 \mathrm{~m} / \mathrm{s}$
14) Velocity of Jet given Normal Thrust Parallel to Direction of Jet
$f \mathrm{x} v=-\left(\sqrt{\frac{\mathrm{Ft} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\mathrm{Jet}} \cdot\left(\angle \mathrm{D} \cdot\left(\frac{180}{\pi}\right)\right)^{2}}}-\mathrm{V}_{\text {absolute }}\right)$
ex $10.04075 \mathrm{~m} / \mathrm{s}=-\left(\sqrt{\frac{0.5 \mathrm{kN} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot\left(11^{\circ} \cdot\left(\frac{180}{\pi}\right)\right)^{2}}}-10.1 \mathrm{~m} / \mathrm{s}\right)$

## Flat Plate Normal to the Jet

15) Absolute Velocity given Thrust Exerted by Jet on Plate
$f \times V_{\text {absolute }}=\left(\sqrt{\frac{m_{f} \cdot G}{\gamma_{f} \cdot \mathrm{~A}_{\mathrm{Jet}}}}\right)+\mathrm{v}$
ex $9.71765 \mathrm{~m} / \mathrm{s}=\left(\sqrt{\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2}}}\right)+9.69 \mathrm{~m} / \mathrm{s}$
16) Dynamic Thrust Exerted on Plate by Jet
$f \mathrm{fx}=\frac{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\text {Jet }} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)^{2}}{\mathrm{G}}$
ex $0.197887 \mathrm{kN}=\frac{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2}}{10}$
17) Efficiency of Wheel
$\mathrm{fx} \eta=\frac{2 \cdot \mathrm{v} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)}{\mathrm{V}_{\text {absolute }}^{2}}$
ex $0.077892=\frac{2 \cdot 9.69 \mathrm{~m} / \mathrm{s} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})}{(10.1 \mathrm{~m} / \mathrm{s})^{2}}$
18) Velocity of jet for mass of fluid striking plate
$\mathrm{f} v=-\left(\left(\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\text {Jet }}}\right)-V_{\text {absolute }}\right)$
Open Calculator
ex $10.09924 \mathrm{~m} / \mathrm{s}=-\left(\left(\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2}}\right)-10.1 \mathrm{~m} / \mathrm{s}\right)$
19) Velocity of jet given dynamic thrust exerted by jet on plate
$f \mathbf{f x}=-\left(\sqrt{\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\text {Jet }}}}-V_{\text {absolute }}\right)$
ex $10.07235 \mathrm{~m} / \mathrm{s}=-\left(\sqrt{\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2}}}-10.1 \mathrm{~m} / \mathrm{s}\right)$
20) Work Done by Jet on Plate per Second
$f \times \mathrm{w}=\frac{\gamma_{\mathrm{f}} \cdot \mathrm{A}_{\text {Jet }} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)^{2} \cdot \mathrm{v}}{\mathrm{G}}$
ex $1.917528 \mathrm{KJ}=\frac{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot 1.2 \mathrm{~m}^{2} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2} \cdot 9.69 \mathrm{~m} / \mathrm{s}}{10}$

## Cross Sectional Area

21) Cross Sectional Area given Dynamic Thrust Exerted by Jet on Plate
$f \times \mathrm{A}_{\text {Jet }}=\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)^{2}}$
ex $5.457651 \mathrm{~m}^{2}=\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2}}$
22) Cross Sectional Area given Mass of Fluid Striking Plate
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W
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$f \mathbf{x} \mathrm{~A}_{\text {Jet }}=\frac{\mathrm{m}_{\mathrm{f}} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)}$
ex $2.237637 \mathrm{~m}^{2}=\frac{0.9 \mathrm{~kg} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})}$
23) Cross Sectional Area given Work Done by Jet on Plate per Second
$f \mathbf{x} \mathrm{~A}_{\text {Jet }}=\frac{\mathrm{w} \cdot \mathrm{G}}{\gamma_{\mathrm{f}} \cdot\left(\mathrm{V}_{\text {absolute }}-\mathrm{v}\right)^{2} \cdot \mathrm{v}}$
ex $2.440642 \mathrm{~m}^{2}=\frac{3.9 \mathrm{KJ} \cdot 10}{9.81 \mathrm{kN} / \mathrm{m}^{3} \cdot(10.1 \mathrm{~m} / \mathrm{s}-9.69 \mathrm{~m} / \mathrm{s})^{2} \cdot 9.69 \mathrm{~m} / \mathrm{s}}$

## Variables Used

- $\angle \mathrm{D}$ Angle between Jet and Plate (Degree)
- A Jet Cross Sectional Area of Jet (Square Meter)
- Ft Thrust Force (Kilonewton)
- G Specific Gravity of Fluid
- $\mathbf{m}_{\mathrm{f}}$ Fluid Mass (Kilogram)
- v Velocity of Jet (Meter per Second)
- $\mathbf{V}_{\text {absolute }}$ Absolute Velocity of Issuing Jet (Meter per Second)
- $\mathbf{V}_{\mathbf{j}}$ Jet Velocity (Meter per Second)
- $\mathbf{v}_{\mathbf{j e t}}$ Fluid Jet Velocity (Meter per Second)
- w Work Done (Kilojoule)
- $\mathbf{Y}_{\mathbf{f}}$ Specific Weight of Liquid (Kilonewton per Cubic Meter)
- $\boldsymbol{\eta}$ Efficiency of Jet
- $\boldsymbol{\theta}$ Theta (Degree)


## Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288

Archimedes' constant

- 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 ( $\mathrm{m}^{2}$ )

Area Unit Conversion

- Measurement: Speed in Meter per Second (m/s)

Speed Unit Conversion

- Measurement: Energy in Kilojoule (KJ)

Energy Unit Conversion

- Measurement: Force in Kilonewton (kN)

Force Unit Conversion

- Measurement: Angle in Degree ( ${ }^{\circ}$ )

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
- Force Exerted by Fluid Jet on Moving Flat Plate Formulas

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