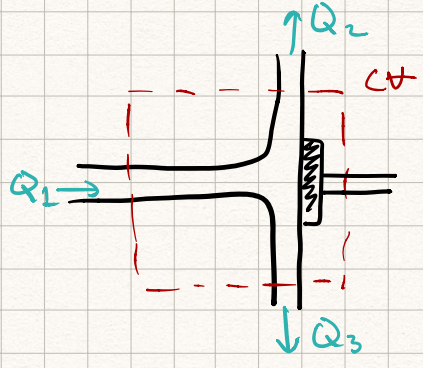
ME C.E. : $0 = \frac{dM_{CV}}{dt} + (\dot{m}_{out} - \dot{m}_{in})$

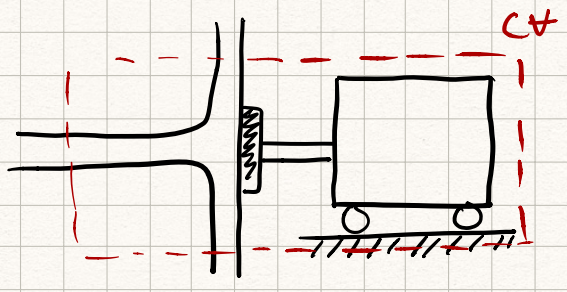
Steady. State : $\Sigma \dot{m}_{out} = \Sigma \dot{m}_{in}$

$\Sigma Q_{out} = \Sigma Q_{in}$

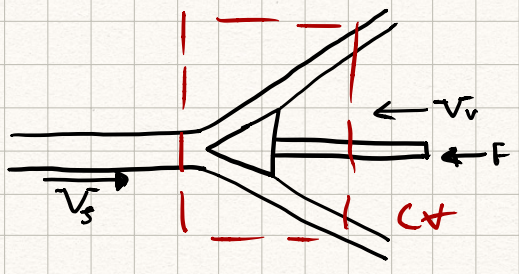


$Q_2 + Q_3 = Q_1$

Moving CV



or

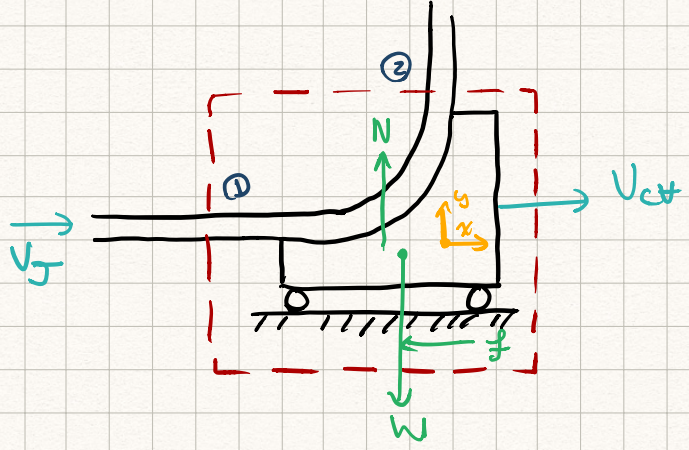


$Q = VA$

Relative Velocity

$\vec{V}_{J/CV} = \vec{V}_J - \vec{V}_{CV} = 10 - (-5) = 15$ m/s

Example :



Steady State

f = ?

$Q_1 = V_{J/CV} A$

Relative Velocity

$\vec{V}_{J/CV} = \vec{V}_J - \vec{V}_{CF}$

at ① and ②

1 - CV
2 - FD
3 - $Q\vec{V}_{out} - Q\vec{V}_{in}$

① $\vec{V}_{J/CV} = \vec{V}_J - \vec{V}_{CV}$ $\Rightarrow -f = \rho\left[0 - (V_J - V_{CV})A(V_J - V_{CV})\right]$

② 0

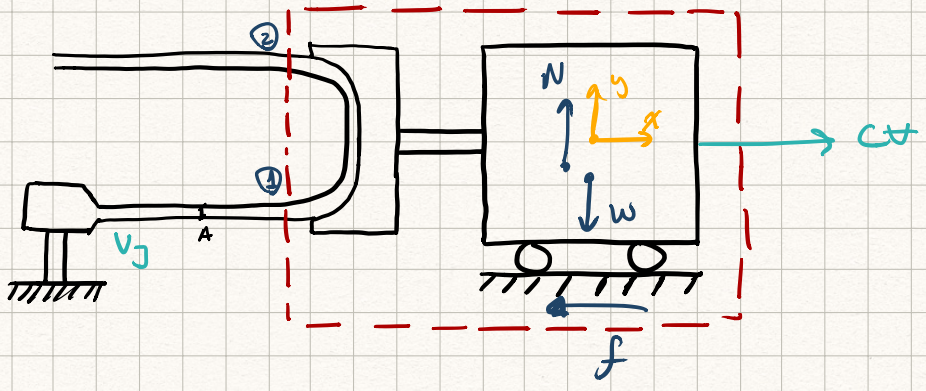
$$f = \rho A (V_J - V_{CV})^2$$

Q_2 ?

C.E: $Q_1 = Q_2$

Example:

Steady State: $f = ?$



① $\vec{V}_{J/CV} = \vec{V}_J - \vec{V}_{CV}$

$\rightarrow$ $V_{J/CV} = V_J - V_{CV}$

$Q_1 = V_{J/CV} A = (V_J - V_{CV}) A$

② $\vec{V}_{J/C} = (\vec{V}_2 - \vec{V}_{CV}) X$

CE: $Q_1 = Q_2$

$(V_{J/CV} A)_1 = (V_{J/CV} A)_2$

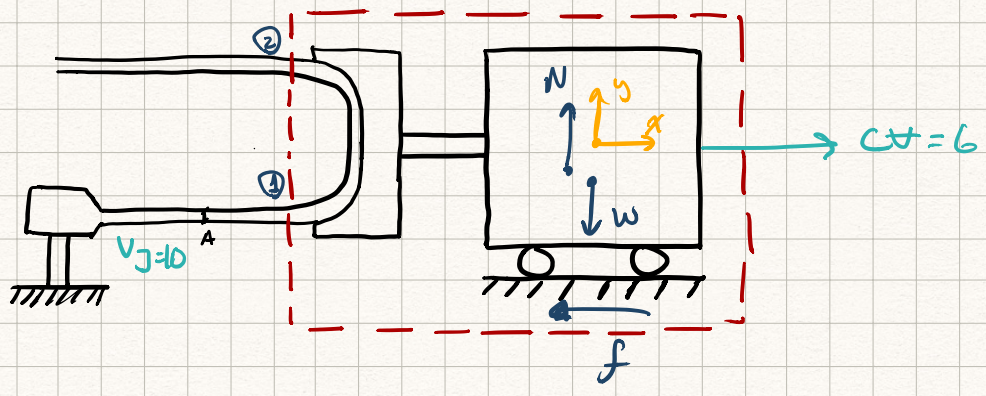
$A_1 = A_2$

$(V_{J/CV})_1 = (V_{J/CV})_2$

$$-f = \rho\left[-(V_J - V_{CV}) A (V_J - V_{CV}) - (V_J - V_{CV}) A (V_J - V_{CV})\right]$$

$$f = 2\rho\left[(V_J - V_{CV})^2 A\right]$$

Example



$\frac{V_{in}}{V_{out}}$ } actual

① $\begin{cases} V_J = 10\ m/s \end{cases}$

② $\begin{cases} V_2 = ? \Rightarrow \frac{\vec{V}_2}{CV} = \vec{V}_2 - \vec{V}_{CV} \\ Q_1 = Q_2 \Rightarrow V_{J/CV} = V_{2/CV} \\ V_2 = 2\ m/s \quad \Leftarrow -4 = V_2 - 6 \end{cases}$