

Relative velocity

Engineering Fluid Mechanics

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$$\frac{dB_{sys}}{dt} = \frac{d}{dt} \int_{CV} \rho b dV + \int_{CS} \rho b (\vec{V}_r \cdot \hat{n}) dA$$

$$V_{FLUID,r} = V_{FLUID,g} - V_{CV,g}$$

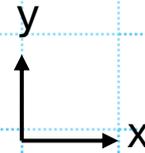
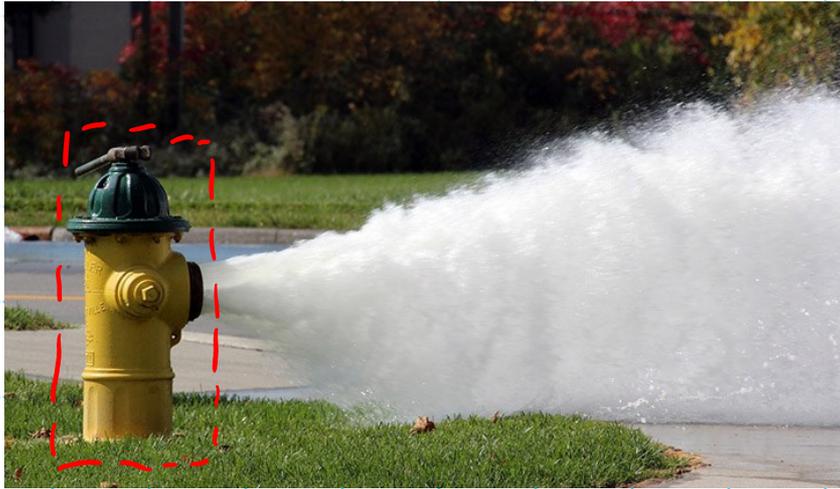
VELOCITY OF FLUID
RELATIVE TO CV

VELOCITY OF
FLUID

VELOCITY OF
THE CV

RELATIVE TO A FIXED
REFERENCE POINT
(e.g. THE GROUND)

Velocity in RTT



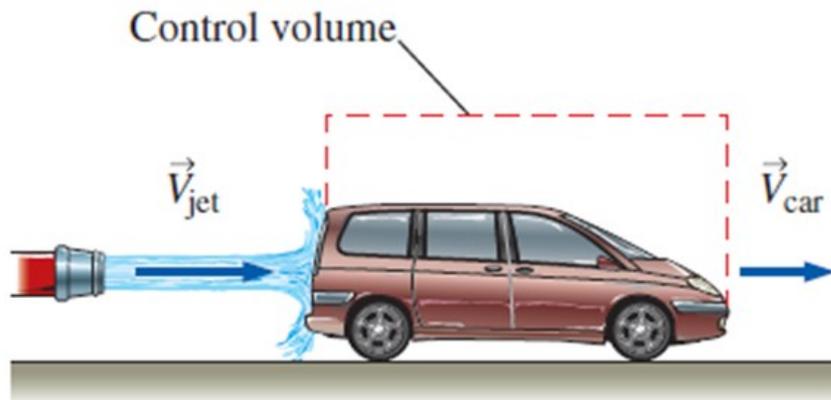
$$V_{fluid,r} = V_{fluid,g} - V_{CV,g}$$

\downarrow \downarrow
2 m/s 0

$$V_{WATER \text{ TO } CV \text{ RELATIVE}} = 2 \text{ m/s} - 0 \text{ m/s}$$
$$= 2 \text{ m/s}$$



Relative velocity for a fixed CV



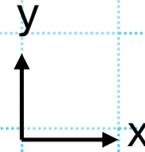
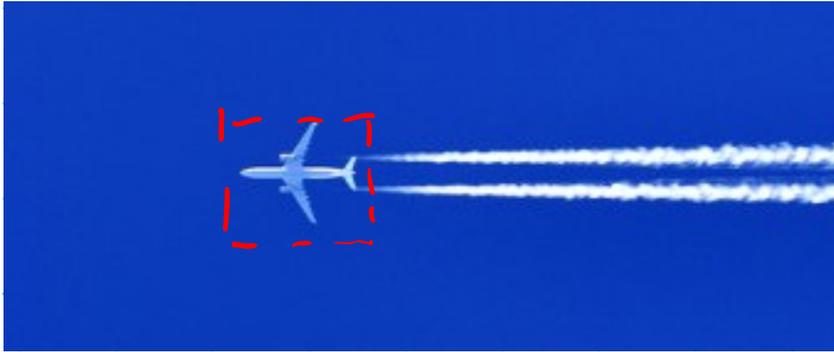
$$V_{fluid,r} = V_{fluid,g} - V_{CV,g}$$

$$V_{CAR} = 1 \text{ ft/s}$$

$$V_{JET} = 8 \text{ ft/s}$$

$$\begin{aligned}
 V_{WATER \text{ RELATIVE TO CV}} &= 8 \text{ ft/s} - 1 \text{ ft/s} \\
 &= 7 \text{ ft/s}
 \end{aligned}$$

Relative velocity for a moving CV



$$V_{fluid,r} = V_{fluid,g} - V_{CV,g}$$

$$V_{EXHAUST} = +800 \text{ km/hr}$$

$$V_{PLANE} = -500 \text{ km/hr}$$

$$\begin{aligned} V_{EXHAUST} \text{ RELATIVE TO CV} &= 800 \frac{\text{km}}{\text{hr}} - (-500 \frac{\text{km}}{\text{hr}}) \\ &= 1300 \text{ km/hr} \end{aligned}$$

Relative velocity for a moving CV





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THE END



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