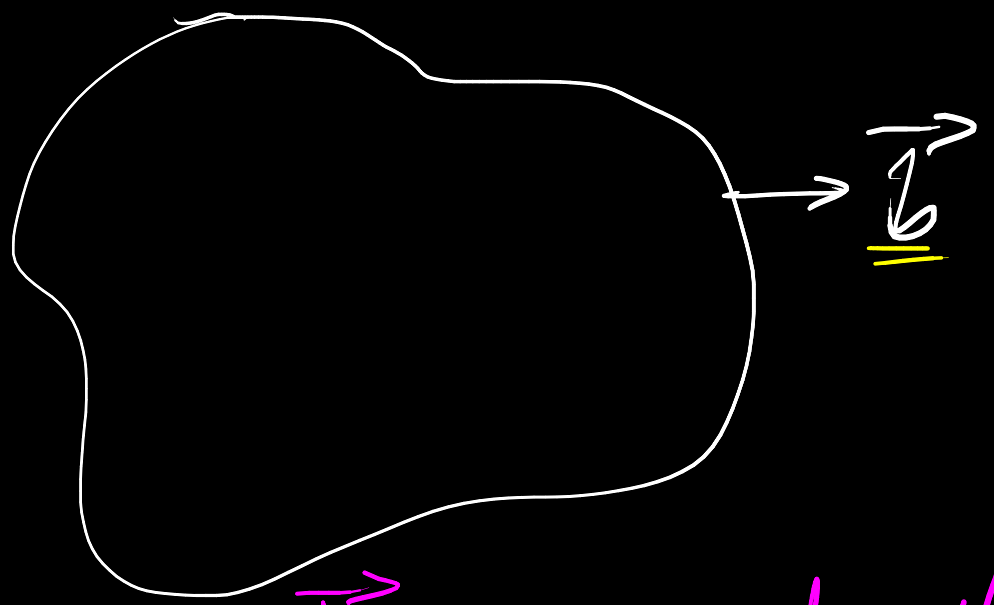


$$\frac{d}{dt}\int_{V} F\,dV = \int_{V} \frac{\partial F}{\partial t}\,dV + \int_A F\,\vec b\cdot\vec n\,dA$$

$\vec b$ can vary locally

$\vec b = \vec u$

Chunk of fluid moves with the fluid

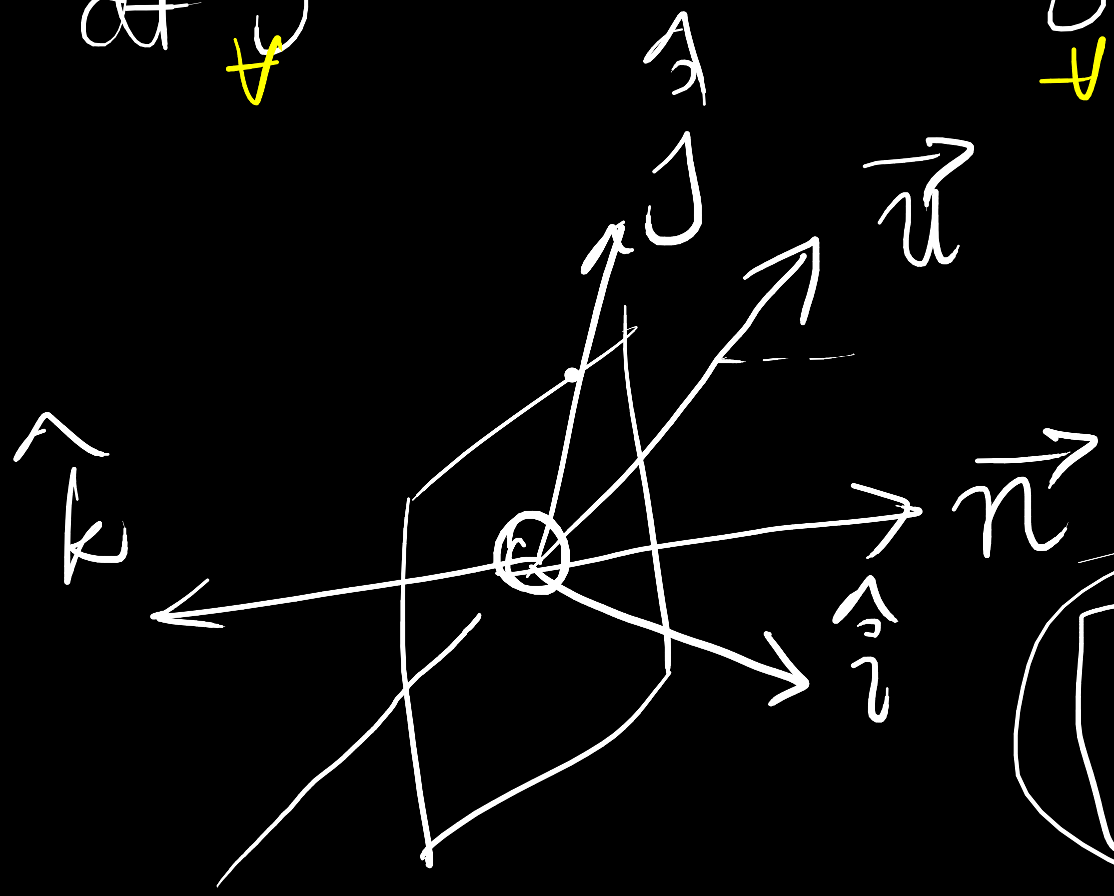
$$\frac{d}{dt}\int F\,dV = \int \frac{\partial F}{\partial t}\,dV + \int F\,\vec u\cdot\vec n\,dA$$

$(\vec u)$

momentum/vol $\quad \rho\vec u$

$$\frac{d}{dt}\int \rho\vec u\,dV = \int_{V} \frac{\partial}{\partial t}(\rho\vec u) + \int_A \rho\vec u\;\vec u\cdot\vec n\,dA$$

$$\frac{d}{dt}\int_{\forall} \rho u \, d\forall = \int_{\forall} \frac{\partial}{\partial t}(\rho u) + \int_{A} \underbrace{\overset{x\ \text{mom}}{\rho u}}_{\text{entity carried by}} \underbrace{\boxed{\vec{u}\cdot\vec{n}\, dA}}_{\text{flux}}$$



$$\boxed{\vec{u}\cdot\vec{n}}$$

$$\left.\begin{array}{ll} \rho(\vec{u}\cdot\hat{i}) & x \text{ mom/vo} \\ \rho\,\vec{u}\cdot\hat{j} & y \ \text{"} \\ \rho\,\vec{u}\cdot\hat{k} & z \ \text{"} \end{array}\right.$$

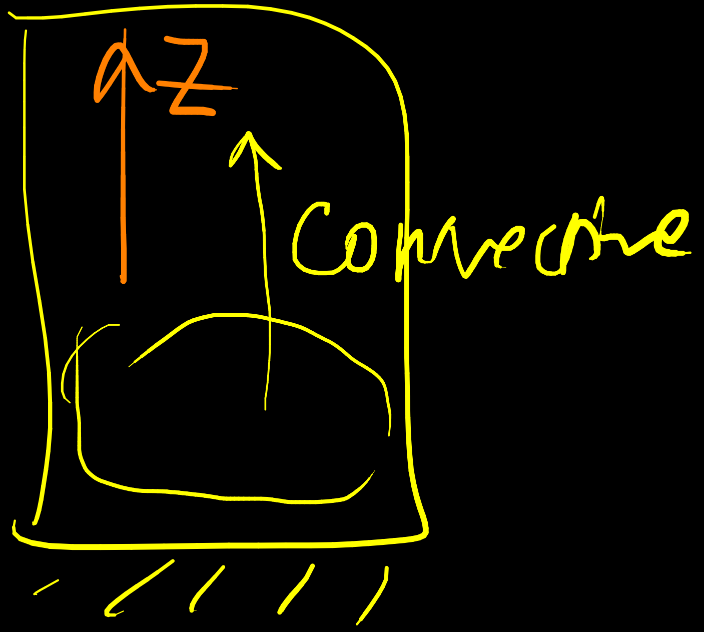
Cause of the rate of ch-mom

$$\int_{\forall}\frac{\partial}{\partial t}(\rho\vec{u})\,d\forall + \int_{A}\rho\vec{u}\;\vec{u}\cdot\vec{n}\,dA = \sum F = F_{body} + F_{surf}.$$

Body force → Acts on total volume

- Gravity
- Electromagnetic
- Magnetic
- Thermal.

$$\int_{V} \rho \vec{g}\, dV$$



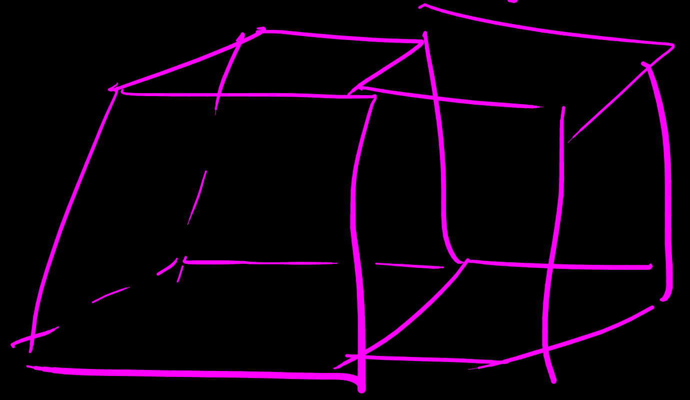
$$F_{b,g} = \int_{V} \rho \vec{g}\, dV \rightarrow \begin{cases} 0 & (x) \\ 0 & (y) \\ -\int \rho g\, dV \end{cases}$$

Conservative / nonconservative

$$\vec{f} = -\nabla \phi$$

$$\rho \vec{g} = -\nabla \phi \Rightarrow \phi = -\rho g z$$

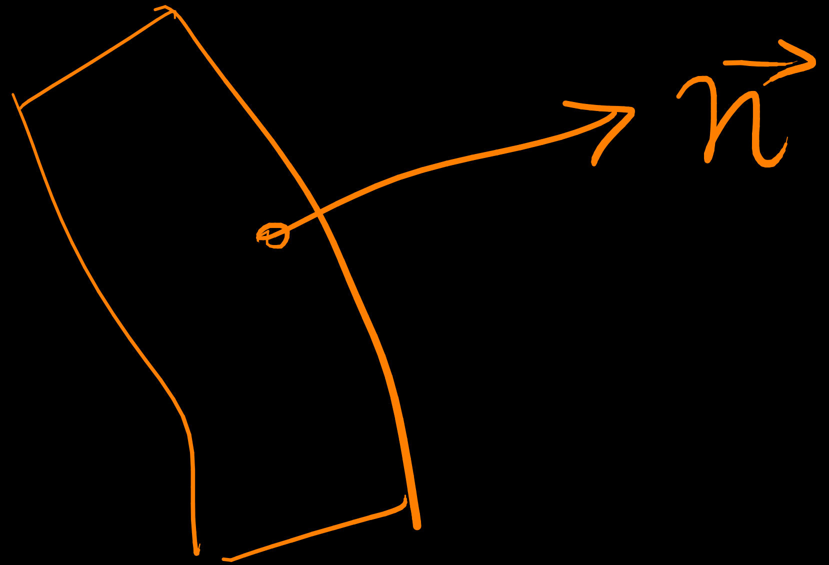
Surface forces



$\vec{f}$ traction vector

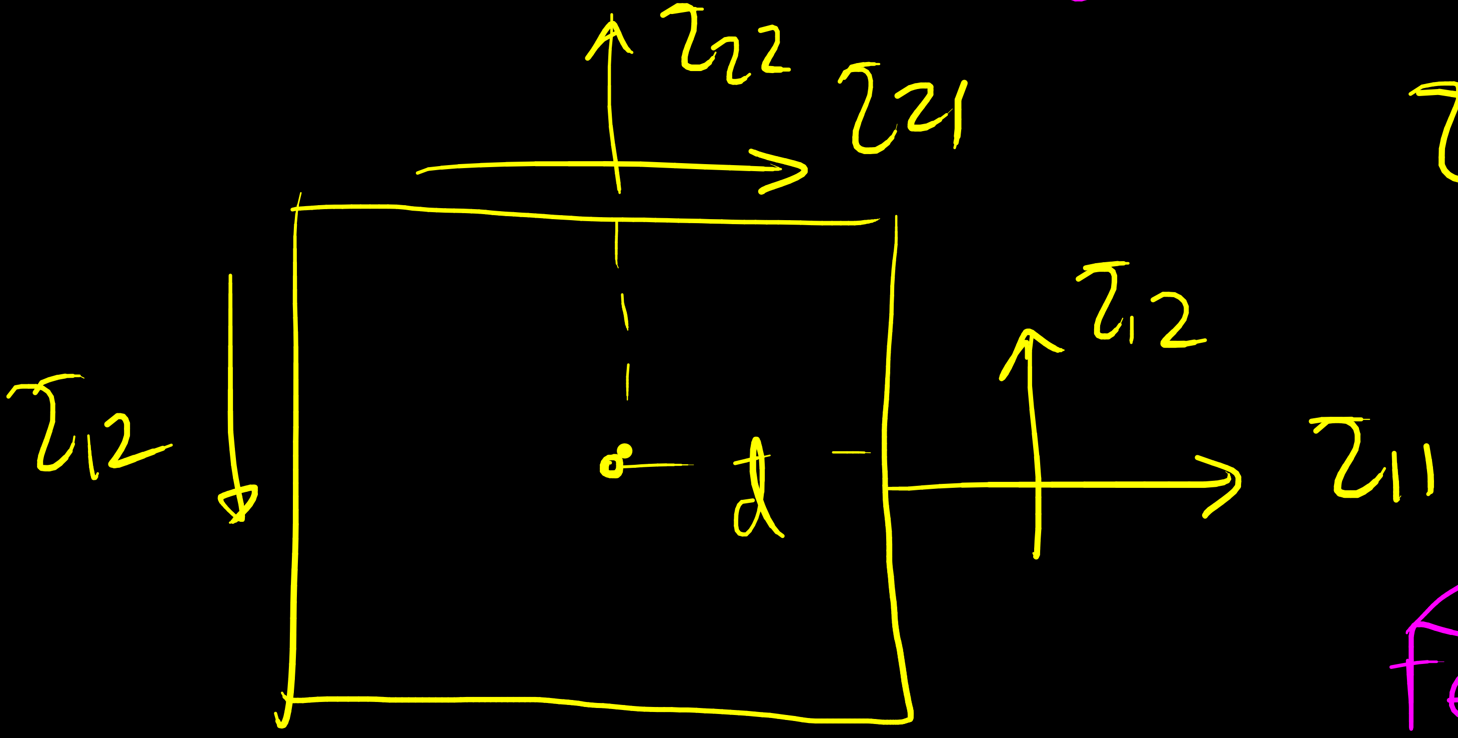
$$\vec{f}_s = \overline{\overline{\tau}} \cdot \vec{n}$$

$$\int_A \vec{f}\, dA$$



$$\boxed{f_j = \tau_{ij}\, n_i}$$

Stress tensor is symmetric



$$\tau_{12} - \tau_{21} = \underbrace{\text{net moment}}_{=0} / d .$$

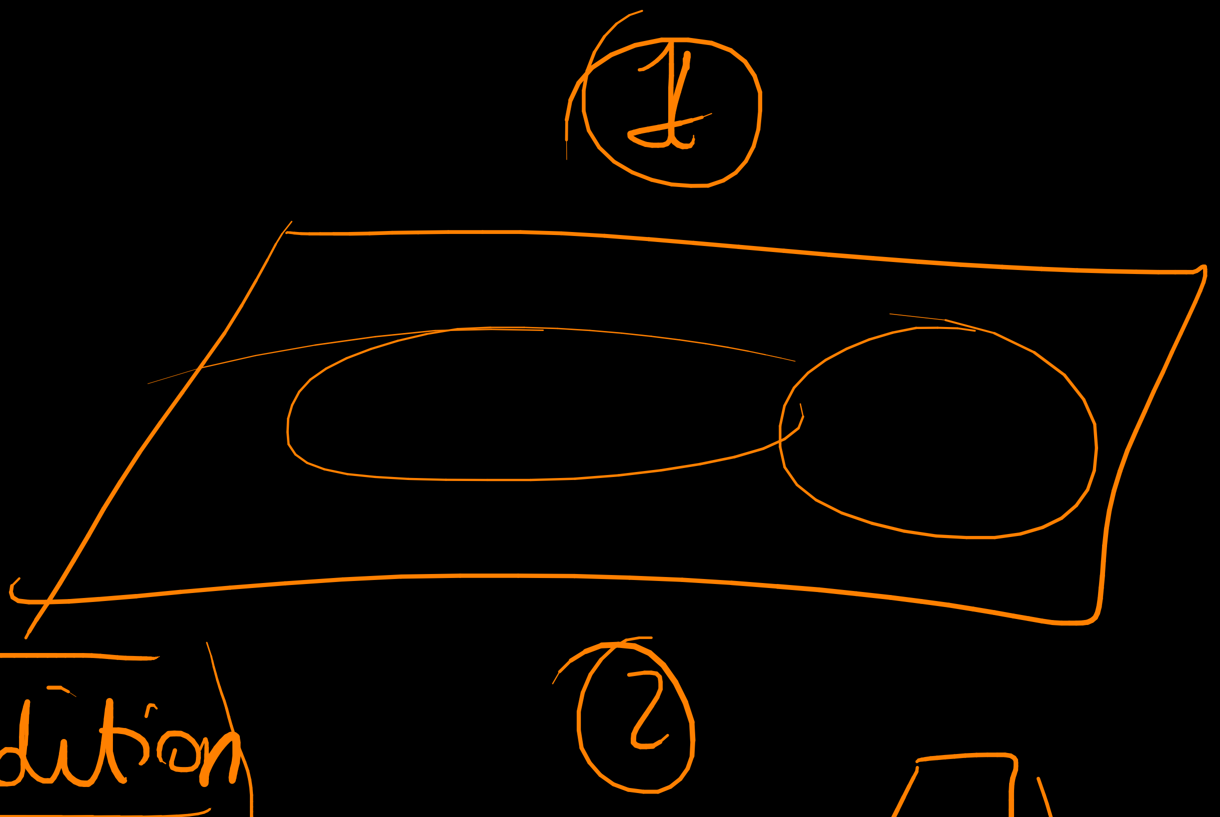
$$\tau_{12} = \tau_{21}$$

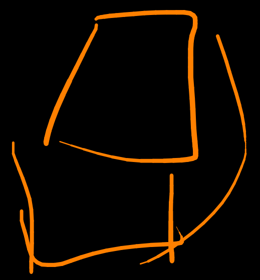
Ferrofluid

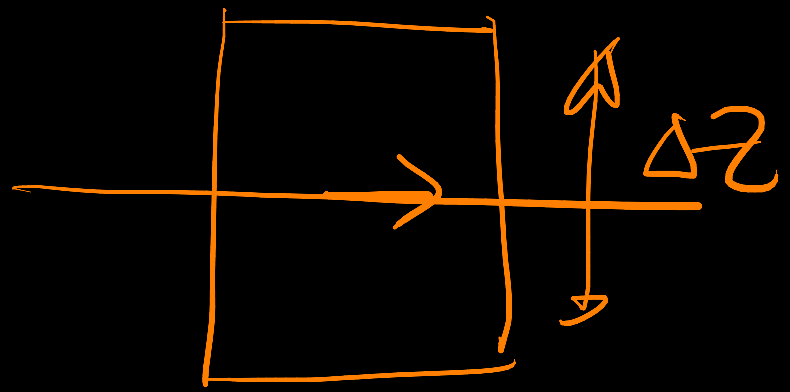
$$\int_{V} \frac{\partial}{\partial t}(\rho \vec{u})\, dV + \int_{A} \rho \vec{u}\, \vec{u}\cdot\vec{n}\, dA = \int_{V} \rho \vec{g}\, dV + \int_{A} \vec{f}\, dA$$

$\boxed{\text{interfacial forces}}$ } surface

Boundary condition





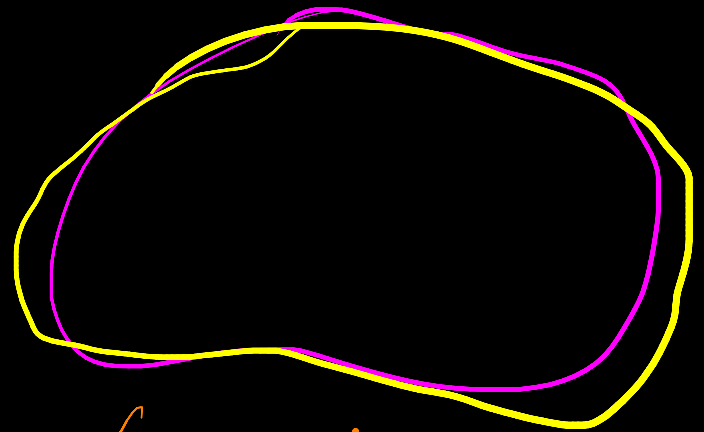


$$\boxed{\int_V \frac{\partial}{\partial t}(\rho\vec{u})\,d\forall} + \int_V \rho\vec{u}\;\vec{u}\cdot\vec{n}\,dA = \int_V \rho\vec{g}\,d\forall + \int_A \vec{f}\,dA$$

Any general CV moving w/ $\underline{\underline{\vec{b}}}$

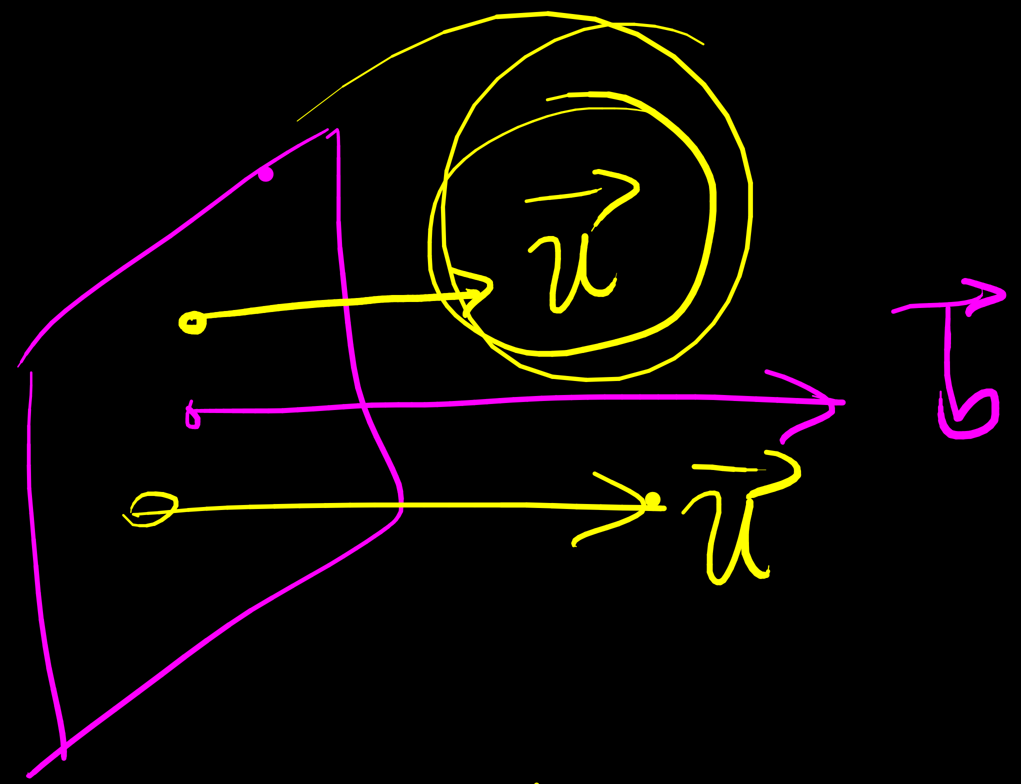
$$\frac{d}{dt}\int_{V^*} \rho\vec{u}\,d\forall = \boxed{\int_{V^*} \frac{\partial}{\partial t}(\rho\vec{u})\,d\forall} + \int_{A^*} \rho\vec{u}\;\vec{b}\cdot\vec{n}\,dA$$

$$\int \frac{\partial}{\partial t}(\rho\vec{u})\,d\forall$$



$$\frac{d}{dt}\int \rho\vec{u}\,d\forall - \int \rho\vec{u}\;\vec{b}\cdot\vec{n}\,dA + \int \rho\vec{u}\;\vec{u}\cdot\vec{n}\,dA = \int \rho\vec{g}\,d\forall + \int \vec{f}\,dA$$

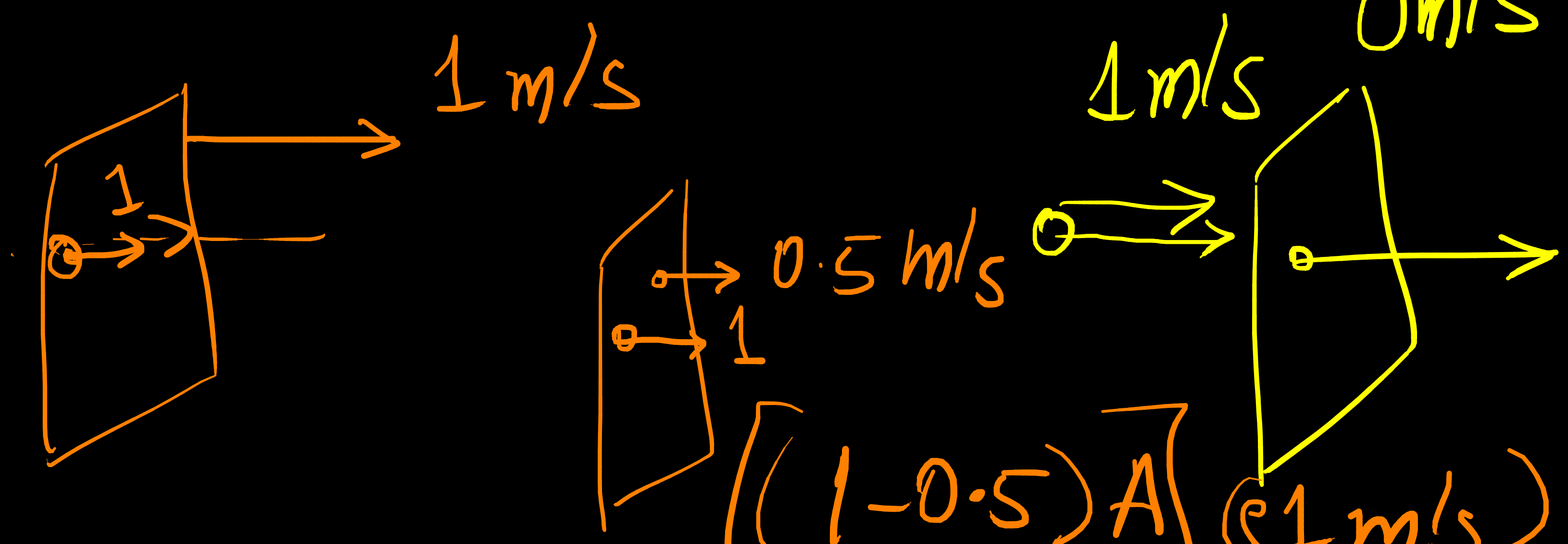
$$\frac{d}{dt}\int \rho\vec{u}\,d\forall + \underline{\int \rho\vec{u}\,(\vec{u}-\vec{b})\cdot\vec{n}\,dA} = \int \rho\vec{g}\,d\forall + \int \vec{f}\,dA$$



$$\underbrace{(\vec{u}-\vec{b})\cdot\vec{n}\,dA}$$

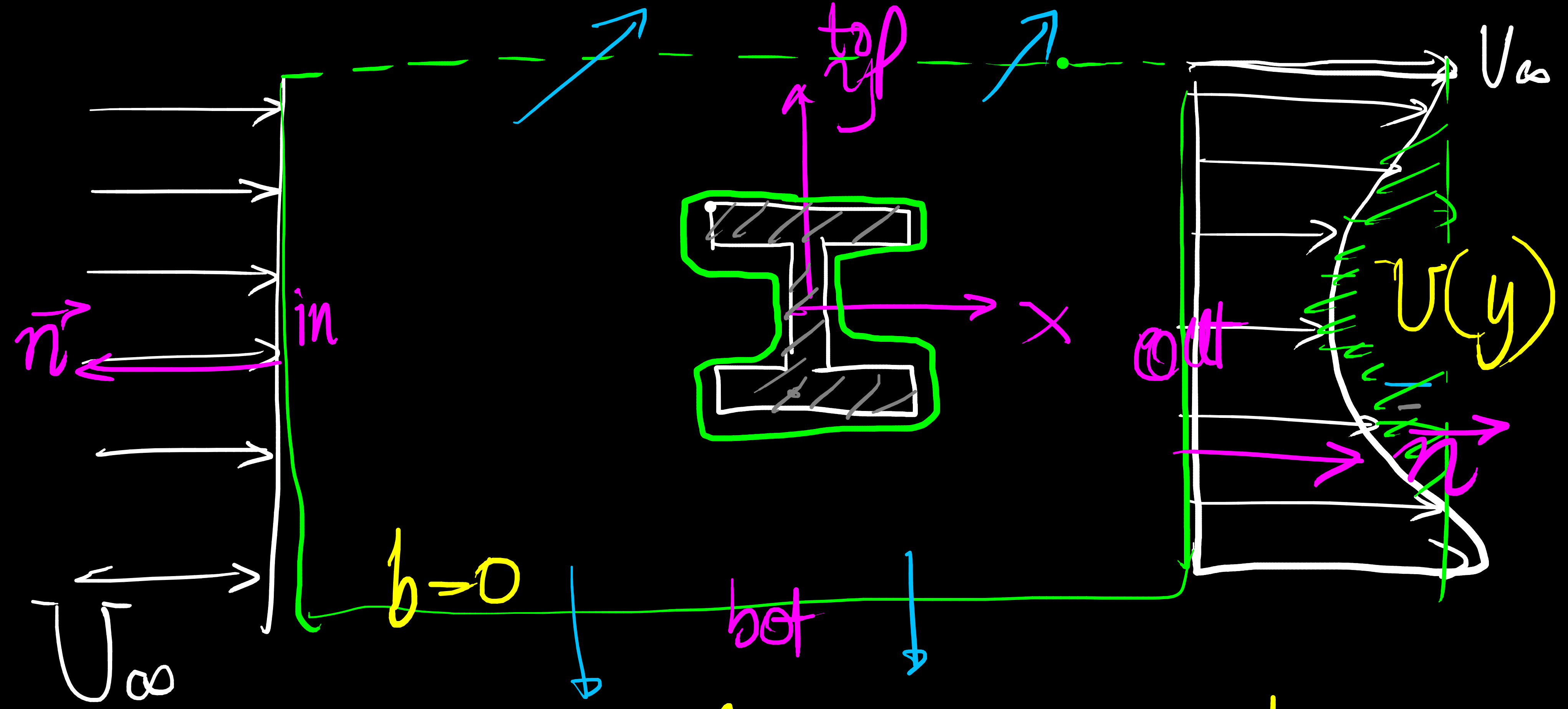
Relative flux to mov. CV

momflux if flux crosses at all



$(1\times A)$

$\boxed{(1-0.5)A}\,(1\,\text{m/s})$



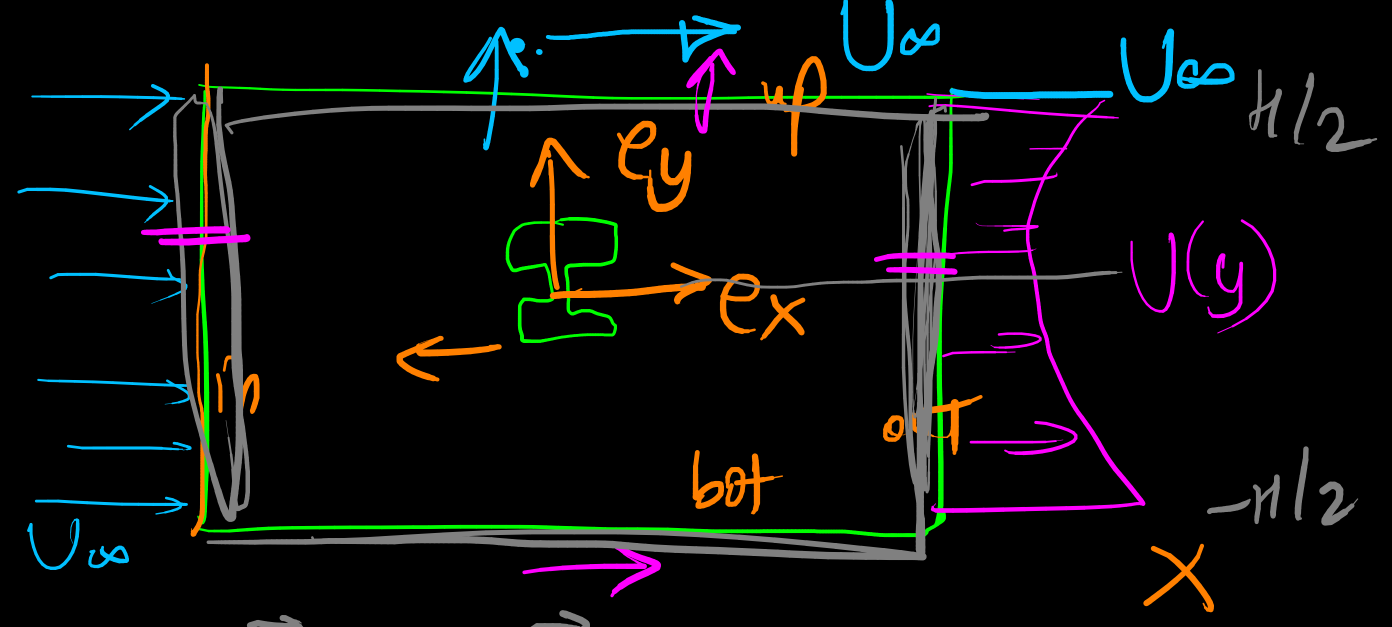
- Find out expr for drag acting on body.

Step 1: Mass conservation

$$\int \rho \, \vec{u} \cdot \vec{n} \, dA = 0$$

$$\int_{in} \rho \vec{u} \cdot \vec{n} \, dA + \int_{out} \rho \vec{u} \cdot \vec{n} \, dA + \int_{up} \rho \vec{u} \cdot \vec{n} \, dA + \int_{bot} \rho \vec{u} \cdot \vec{n} \, dA = 0$$

$$-\int \rho U_\infty \, dA + \int \rho U(y) \, dA + \boxed{\int_{up} \rho \vec{u} \cdot \vec{n} \, dA + \int_{bot} \rho \vec{u} \cdot \vec{n} \, dA} = 0$$



$\vec{u}_{top} = U_\infty \vec{e}_x$

$$\int \rho \vec{u}\, \vec{u}\cdot\vec{n}\, dA = -F_D \vec{e}_x$$

in:

$$\int \rho u\, \vec{u}\cdot\vec{n}\, dA = \int \rho U_\infty (-U_\infty)\, dA$$

out:

$$= \int \rho U(y) (U(y)) dA$$

up, bot:

$$\int_{top} \rho U_\infty \vec{u}\cdot\vec{n}\, dA + \int_{bot} \rho U_\infty \vec{u}\cdot\vec{n}\, dA$$

$$= U_\infty \boxed{\left[\int_{top} \rho \vec{u}\cdot\vec{n}\, dA + \int_{bot} \rho \vec{u}\cdot\vec{n}\, dA \right]}$$

$$\boxed{\underbrace{\int \rho \vec{u}\cdot\vec{n}\, dA}_{\int \rho v\, dx\, \ell} + \underbrace{\int_{bot} \rho \vec{u}\cdot\vec{n}\, dA}_{\int_{bot} \rho v\, dx\, \ell}} = \frac{\int \rho (U_\infty - U(y)) dA}{+ve}$$

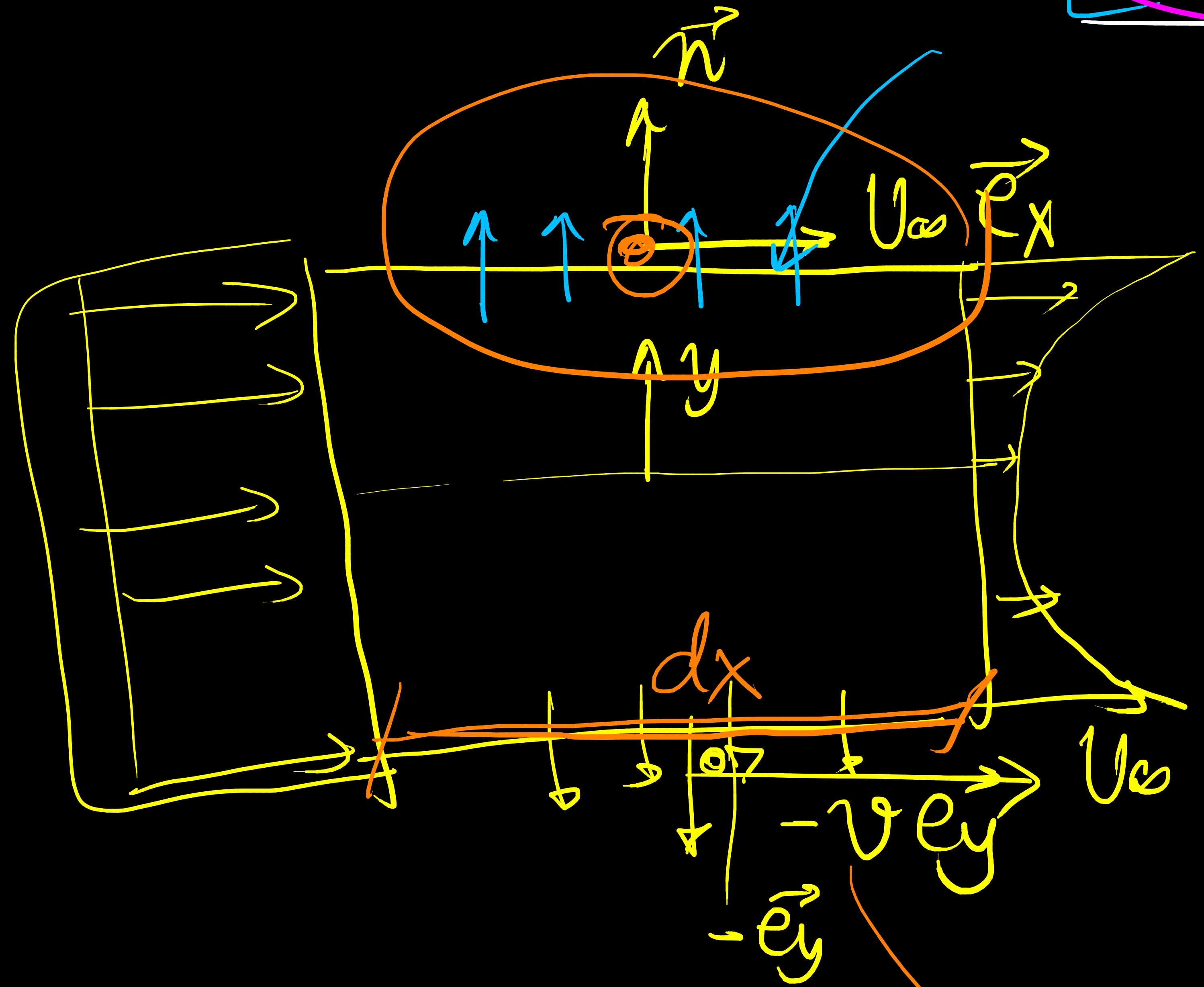
$$+\int \rho U_\infty^2 dA - \int \rho U(y)^2 dA$$

$$+ U_\infty \times \int \rho (-U_\infty + U(y)) \cdot dA = +F_D$$

$$\ell \int \rho U_\infty^2 dy - \ell \int \rho U(y)^2 dy$$

$$+ \int \rho \left(-U_\infty^2 + U_\infty U(y) \right) dy\, \ell = F_D$$

$$\boxed{\frac{F_D}{\ell} = \int_{-H/2}^{H/2} \rho U(y) \left[U_\infty - U(y) \right] dy}$$



$$\left[U_\infty \vec{e}_x + v \vec{e}_y \right]$$

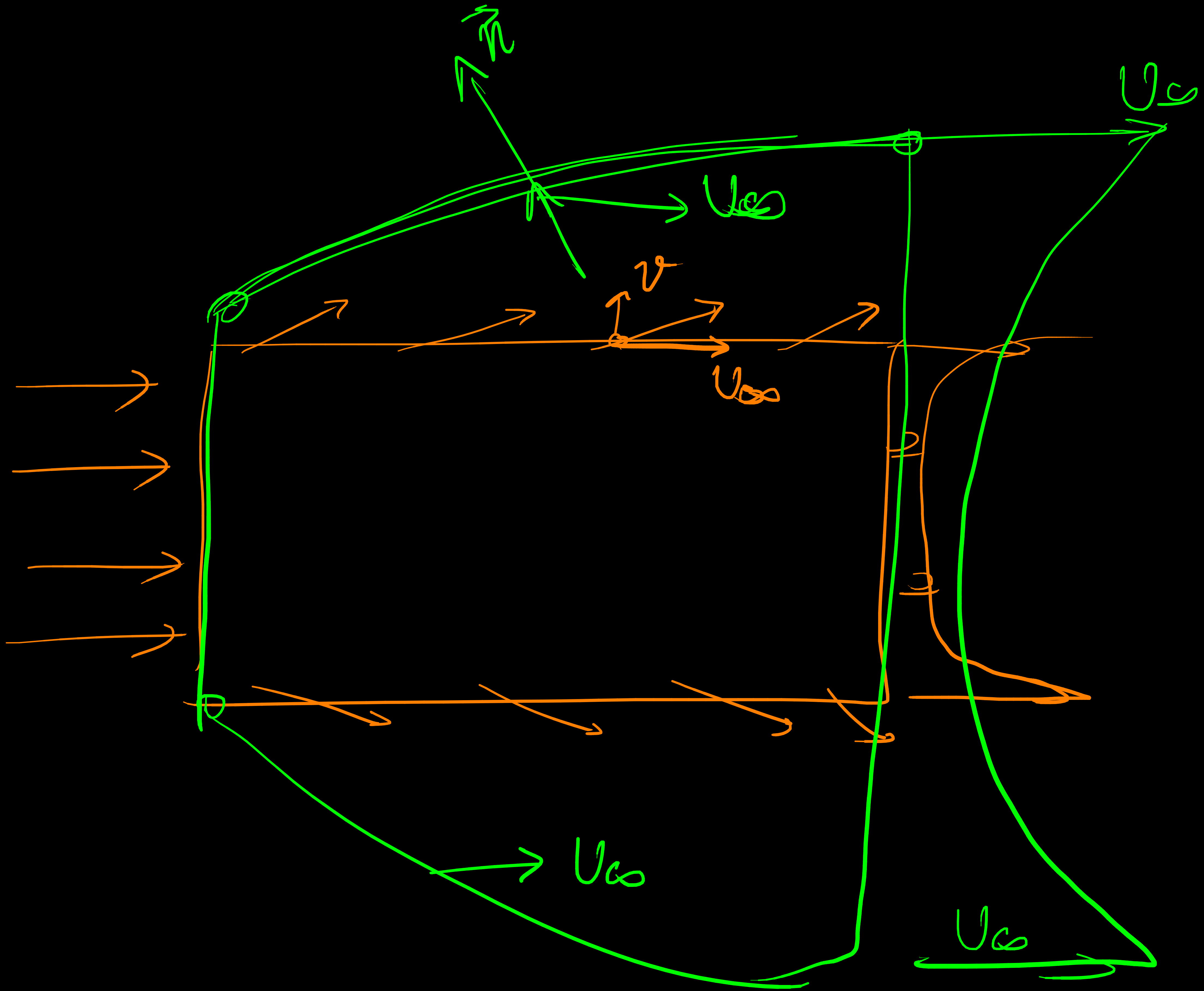
$$\int \boxed{v\,dx\,l}$$

$$\int \rho U_\infty v\,dx\,l$$

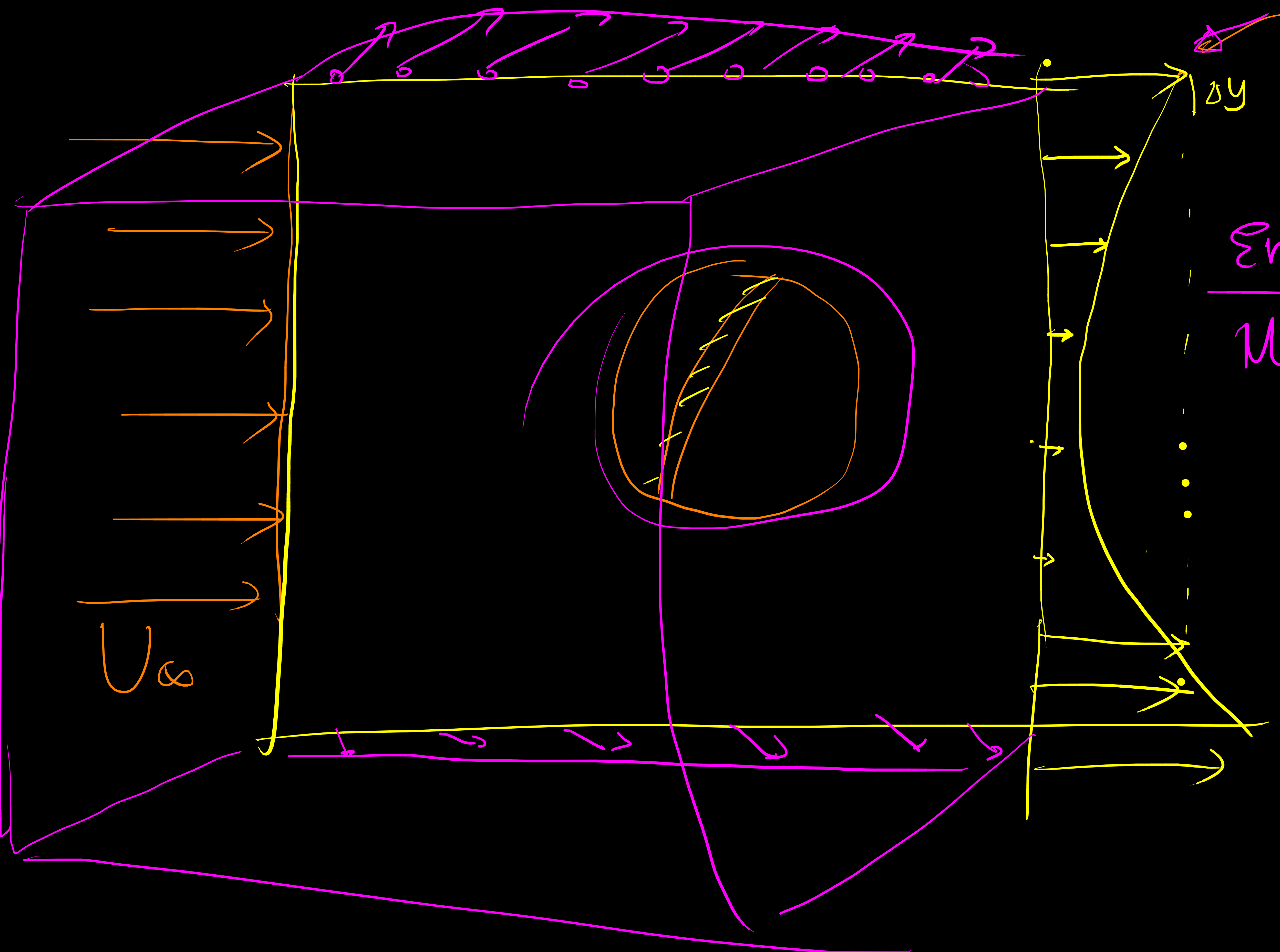
$$\int \rho v\, v\,dx$$

$$\left(U_\infty \vec{e}_x - v \vec{e}_y \right)$$

$$\int -\rho v\, v\,dx$$



$\vec{n}$
U_∞
U_∞
v
U_∞
U_∞
U_∞



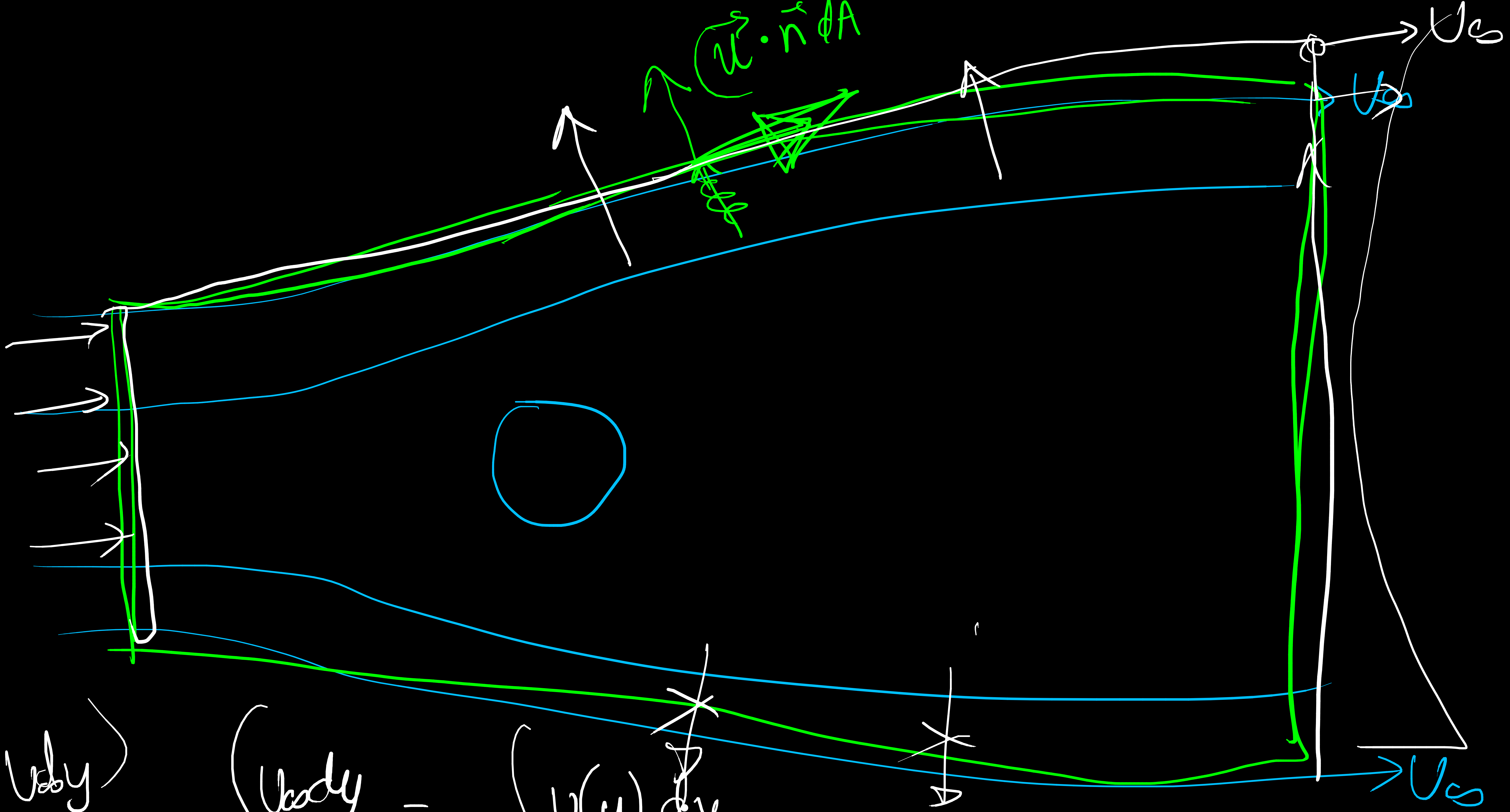
Anemometer

Hot-wire

Laser-Doppler velocimeter

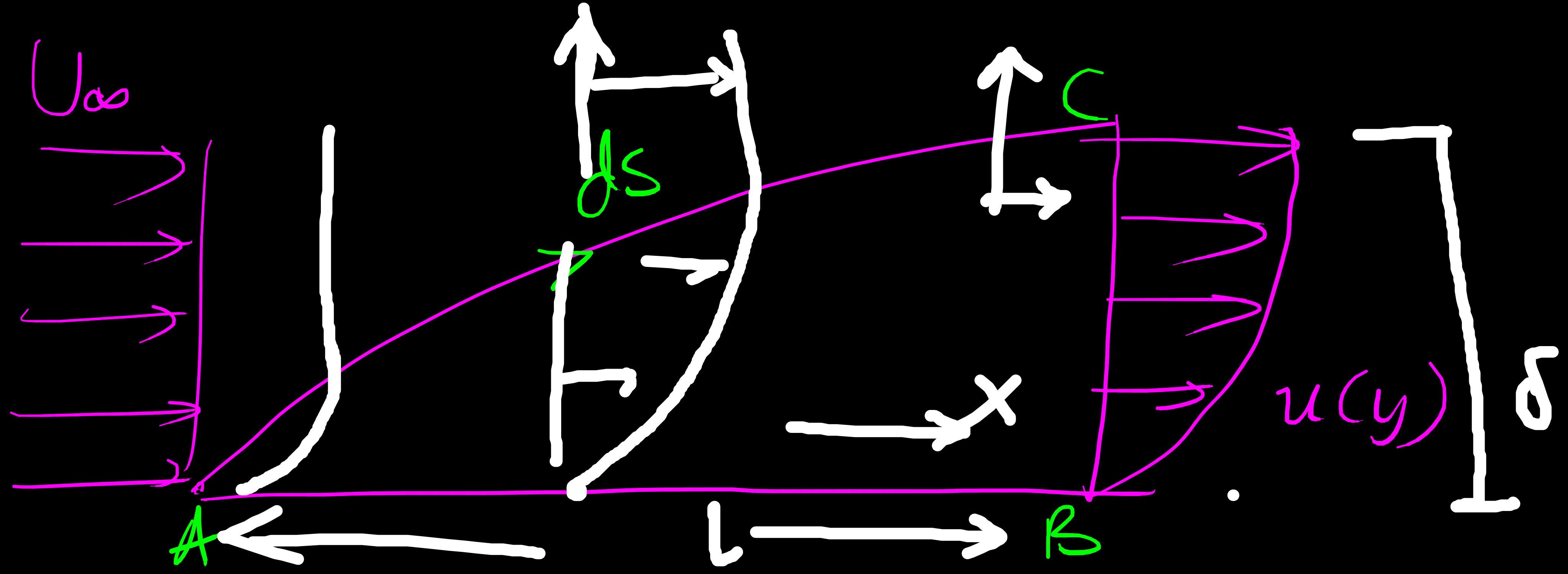
Ensure Mass

Momentum cons.



$(U\,dy)$

$$\int_{A_2} U_\infty\,dy = \int_{\text{large}} u(y)\,dy$$



$$\int_{AC} \rho u \cdot \vec{n}\, ds = -\int_{BC} \rho u\, dy$$

$$F_x = -\int \rho u^2 dy - \int \rho U_\infty \underline{\vec{u} \cdot \vec{n}}\, ds$$

$$= -\int \rho u^2 dy + \int \rho U_\infty u\, dy$$

$$= \int \rho u (U_\infty - u)\, dy = \int_0^\delta \rho \frac{u}{U_\infty}\left(1 - \frac{u}{U_\infty}\right) U_\infty^2\, dy$$

$$F_x = \int_0^1 \rho U_\infty^2 \delta \frac{u}{U_\infty}\left(1 - \frac{u}{U_\infty}\right) d\left(y/\delta\right) \qquad \frac{u}{U_\infty} = 2\left(y/\delta\right) - \left(y/\delta\right)^2$$

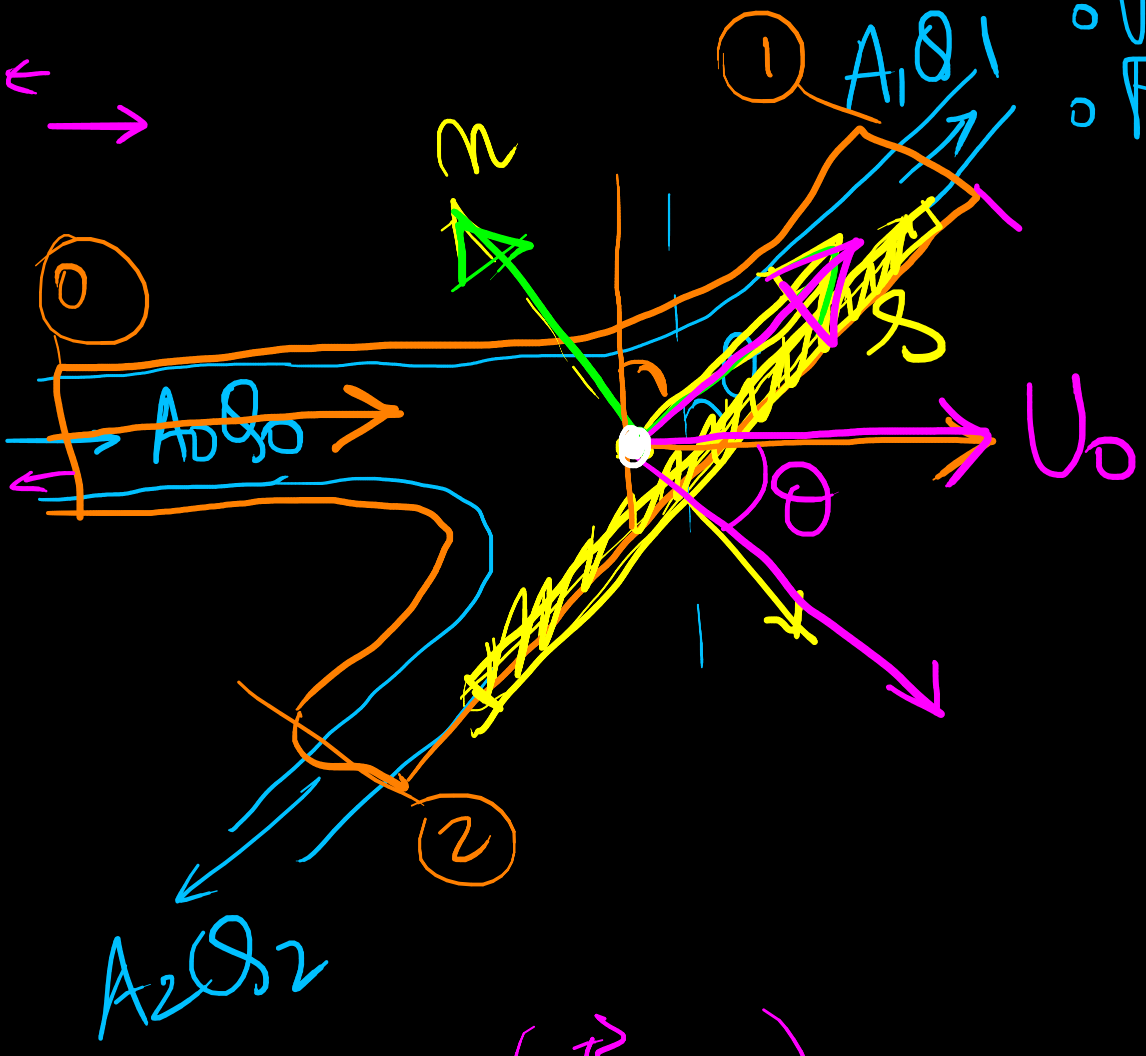
$$= \rho U_\infty^2 \delta \int_0^1 \left(2\bar{y} - \bar{y}^2\right)\left(1 - 2\bar{y} + \bar{y}^2\right) d\bar{y}$$

$$= \rho U_\infty^2 \delta \left[\int_0^1 \left(2\bar{y} - \bar{y}^2 - 4\bar{y}^2 + 2\bar{y}^3 + 2\bar{y}^3 - \bar{y}^4\right) dy\right]$$

$$= \rho U_\infty^2 \delta \left[\int_0^1 \left(2\bar{y} - 5\bar{y}^2 + 4\bar{y}^3 - \bar{y}^4\right) dy\right]$$

$$= \rho U_\infty^2 \delta \left[1 - 5/3 + 1 - \frac{1}{5}\right] \left(1/3 - 1/5\right)$$

$$\boxed{F_x = 2/15\, \rho U_\infty^2 \delta}$$



∘ Velocity uniform

∘ Flow is inviscid / incompr

Momentum:

Vector form

$$\frac{d}{dt}\int \rho\vec{u}\,d\forall + \int \rho\vec{u}\,\boxed{(\vec{u}-\vec{b})\cdot\vec{n}}\,dA = F_s\vec{e}_s + F_n\vec{e}_n$$

$\frac{d}{dt}\int \rho\vec{u}\,d\forall \to 0$

$$\int \rho\vec{u}\,\vec{u}\cdot\vec{n}\,dA$$

0 : $\int \rho(U_0\sin\theta\,\vec{e}_s - U_0\cos\theta\,\vec{e}_n)(-U_0)\,dA$

$$= -\rho[U_0\sin\theta\,\vec{e}_s - U_0\cos\theta\,\vec{e}_n]U_0A_0$$

1 $\rho U_1\vec{e}_s[U_1A_1]$ 2 $[-\rho U_2]\vec{e}_s[U_2A_2]$

$$\rho U_1Q_1\vec{e}_s - \rho U_2Q_2\vec{e}_s - \rho Q_0U_0\sin\theta\,\vec{e}_s + \rho Q_0U_0\cos\theta\,\vec{e}_n = F_s\vec{e}_s + F_n\vec{e}_n$$

$$F_s = \rho U_1Q_1 - \rho U_2Q_2 - \rho Q_0U_0\sin\theta$$

$$F_n = \rho Q_0U_0\cos\theta$$

cons. mass $(\vec{b}=0)$

$$\frac{d}{dt}\int \rho\,d\forall + \int \rho(\vec{u}-\vec{b})\cdot\vec{n}\,dA = 0$$

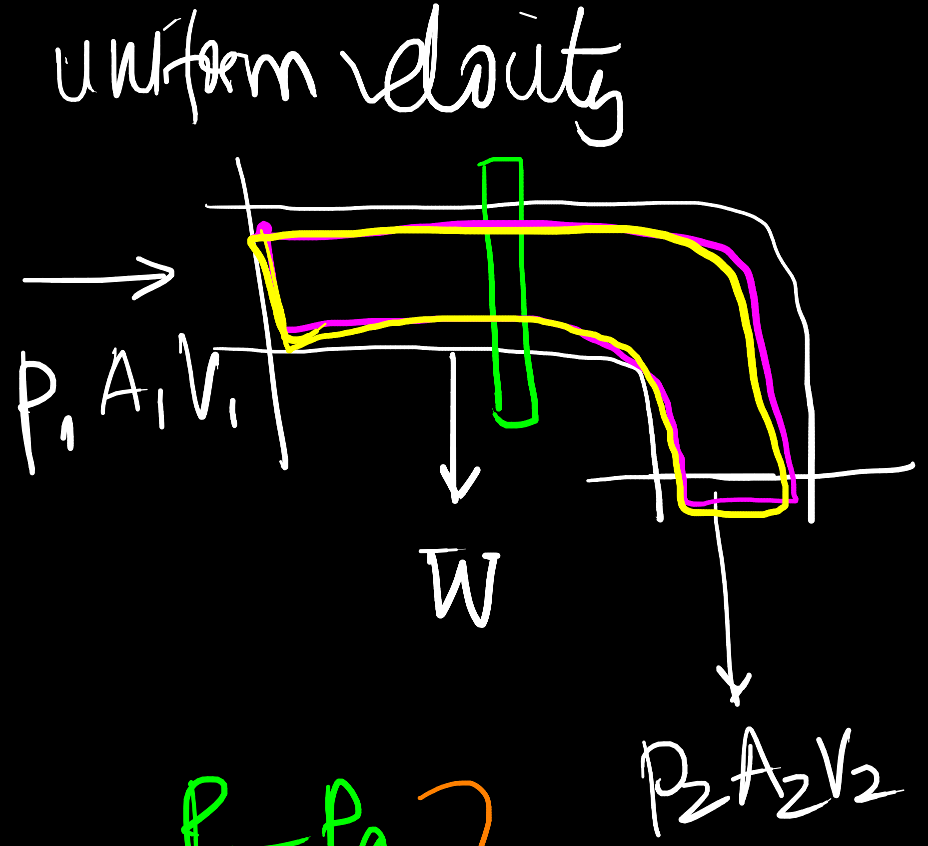
$\frac{d}{dt}\int \rho\,d\forall \to 0$

$$\int \rho\vec{u}\cdot\vec{n}\,dA = 0$$

$$-\rho Q_0 + \rho Q_1 + \rho Q_2 = 0$$

$$Q_1 + Q_2 = Q_0$$

$$A_1V_1 + A_2V_2 = A_0V_0$$



w
e
b

$\boxed{F_{el,\,bract} + F_{weight,\,el} + F_{el,\,water} = 0}$ static eqm

$F_{water,\,el}$.

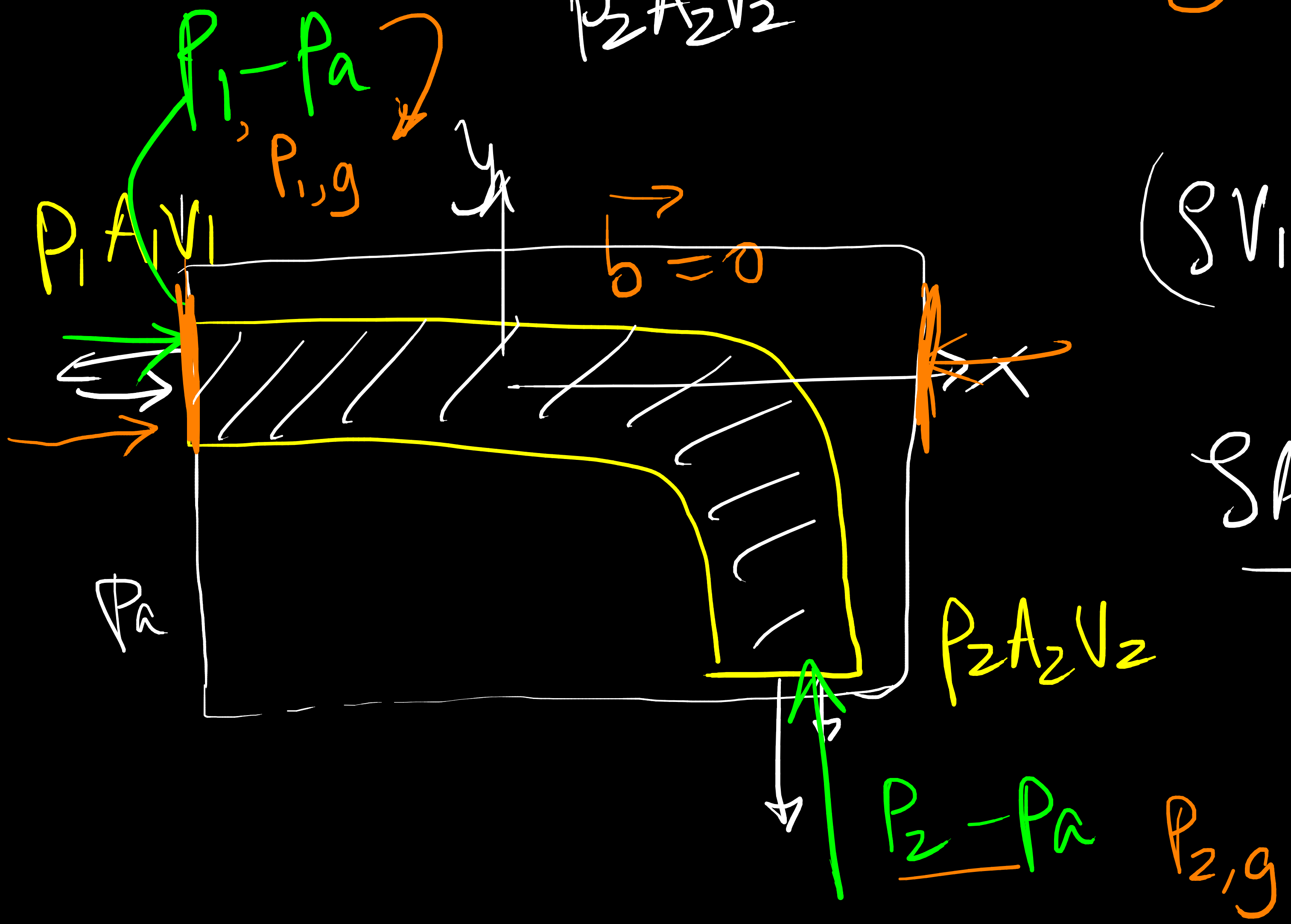
$$\cancel{\frac{d}{dt}\int \rho \vec{u}\, d\forall} + \int \rho \vec{u}\; \vec{u}\cdot\vec{n}\; dA = \vec{F}_{cv}$$

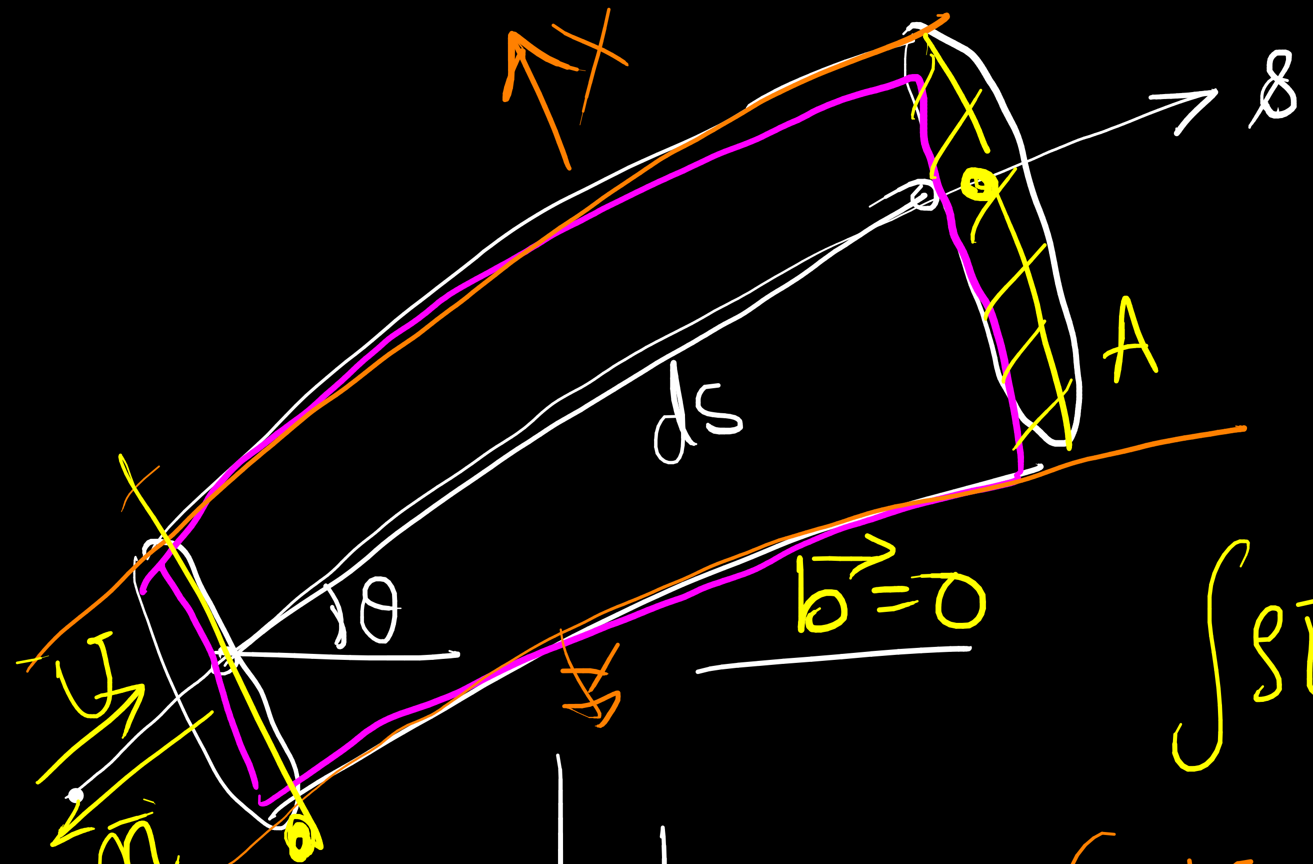
$$\int \rho \vec{u}\; \vec{u}\cdot\vec{n}\, dA = \vec{F}_{cv}$$

$$(\rho V_1 \vec{e}_x)(-V_1 A_1) + \rho V_2(-\vec{e}_y)(-V_2 A_2) = \vec{F}_{cv}$$

$$\rho A_2 V_2^2(\vec{e}_y) - \rho A_1 V_1^2(\vec{e}_x) = \vec{F}$$

$$= P_{1,g} A_1 \vec{e}_x + P_{2,g} A_2 \vec{e}_y + \forall \rho_w g(-\vec{e}_y) + F_{water,\,eb}.$$

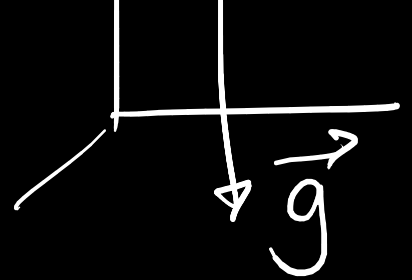




$$\frac{p}{\rho} + \frac{1}{2}U^2 + gz = \text{const.}$$

$$\underline{\frac{d}{dt}\int \rho \, d\forall} + \int \rho(\vec{u}-\vec{b})\cdot\vec{n}\, dA = 0 \rightarrow \boxed{\int \rho \vec{u}\cdot\vec{n}\, dA = 0}$$

$$\int \rho \vec{u}\, \vec{u}\cdot\vec{n}\, dA = \int \rho \vec{g}\, d\forall + \int -p\vec{n}\, dA$$



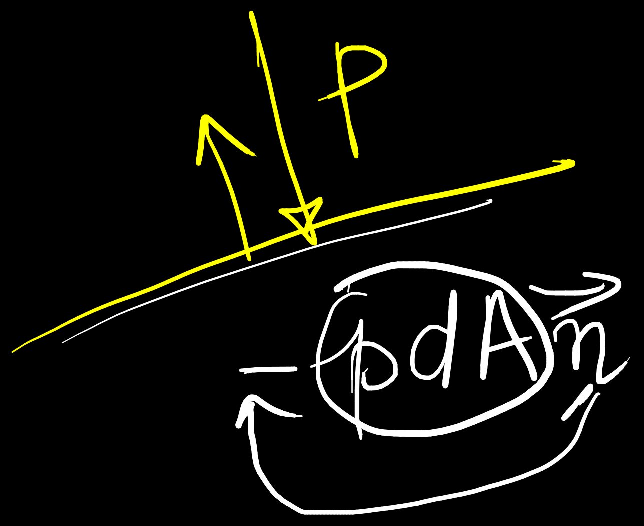
Cons. of mass

A(s+ds)

left face $\int \rho U dA = -\underline{\rho U A}$

$$\int \rho\left(U + \frac{\partial U}{\partial s}ds\right) dA$$

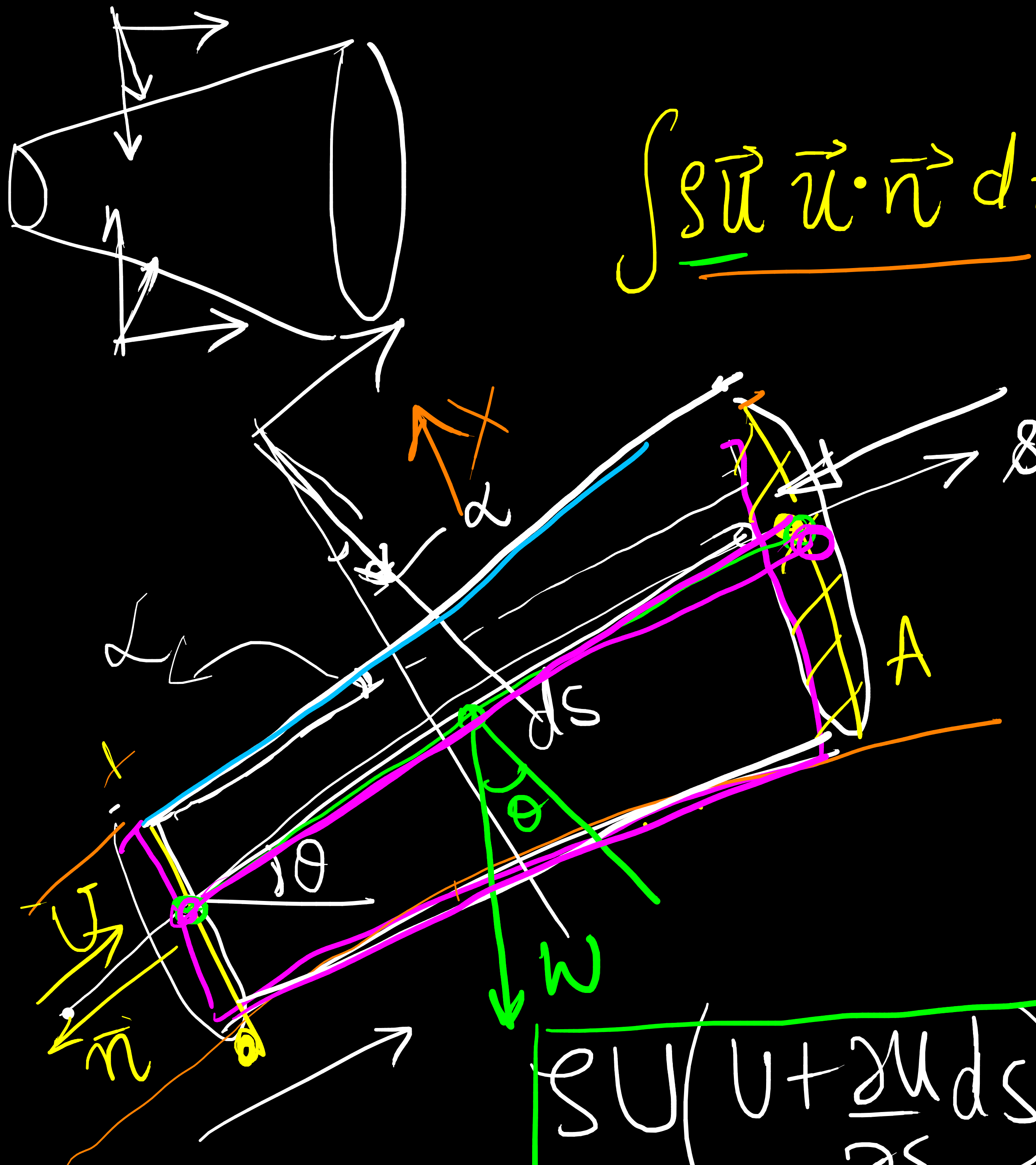
$$= \rho\left(U + \frac{\partial U}{\partial s}ds\right)\left(A + \frac{\partial A}{\partial s}ds\right)$$



$$\rho\left(U + \frac{\partial U}{\partial s}ds\right)\left(A + \frac{\partial A}{\partial s}ds\right) - \rho U A = 0$$

$$\vec{F}_{w,el} = \rho A_2 V_2^2 (\vec{e_y}) - \rho A_1 V_1^2 \vec{e_x} - P_{1g} A_1 \vec{e_x} - P_{2g} A_2 \vec{e_y} + \rho_w g \forall_w \vec{e_y}$$

$$\vec{F}_{el,w} = -\vec{F}_{w,el}$$



$$\int \rho \vec{u}\,\vec{u}\cdot\vec{n}\,dA = \int \rho \vec{g}\,d\forall + \int -p\vec{n}\,dA$$

$$\int \rho U(-U)\,dA = -\rho U^2 A$$

$$\int \rho\left(U+\frac{\partial U}{\partial s}ds\right)\left(U+\frac{\partial U}{\partial s}ds\right)dA$$

$$= \rho\left(U+\frac{\partial U}{\partial s}ds\right)^2\left(A+\frac{\partial A}{\partial s}ds\right)$$

$$= \rho\left(U+\frac{\partial U}{\partial s}ds\right)(UA)$$

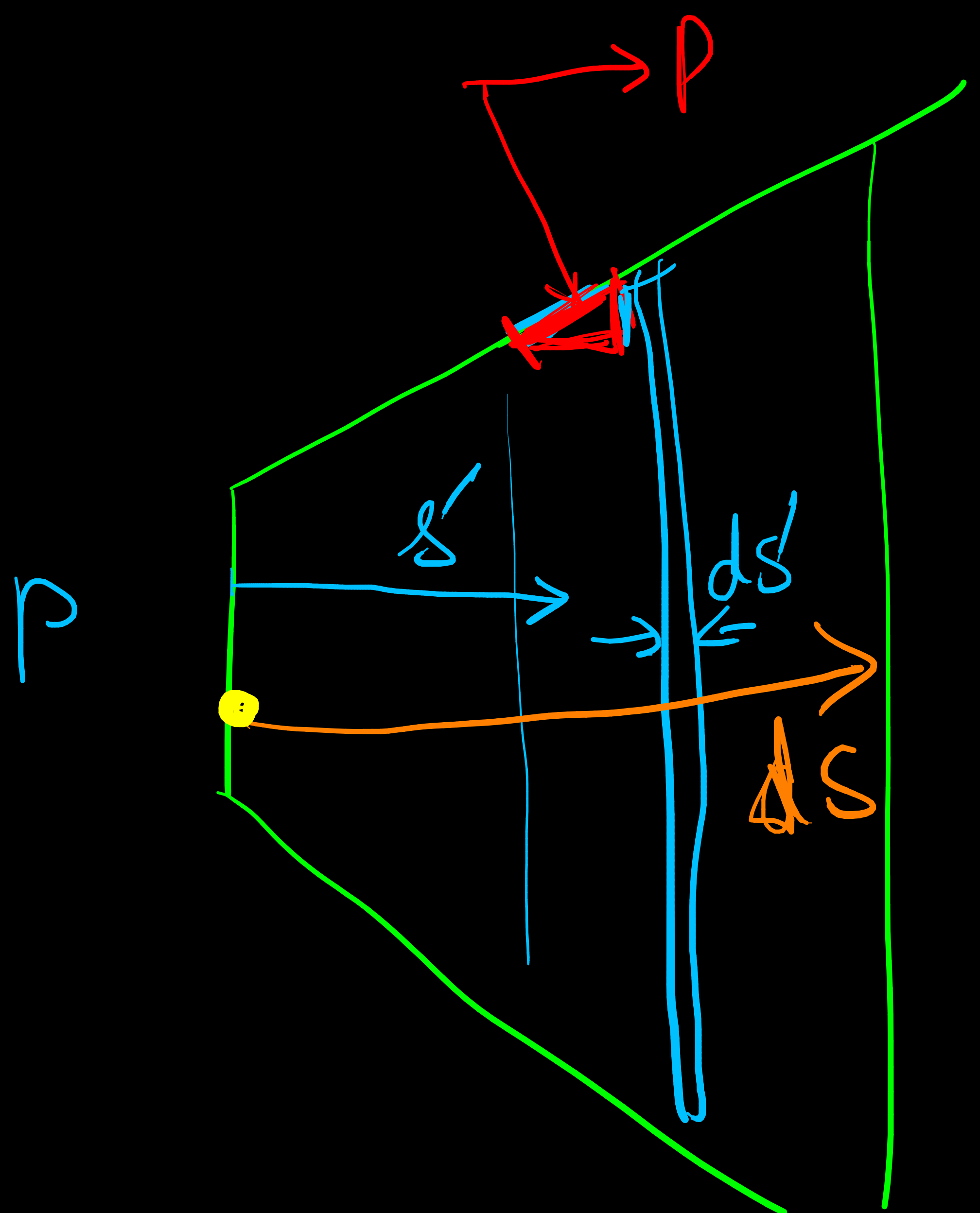
$$\rho U A = \rho\left(U+\frac{\partial U}{\partial s}ds\right)\left(A+\frac{\partial A}{\partial s}ds\right)$$

$$\boxed{\rho U\left(U+\frac{\partial U}{\partial s}ds\right)A - \rho U^2 A} = F_W + F_{p_n} + F_{pp}$$

$$F_W = -\rho g\,ds\left(A+\frac{\partial A}{\partial s}\frac{ds}{2}\right)\sin\theta$$

F_{pn} $\qquad \int p\,dA = pA$

$$-\int \left(p+\frac{\partial p}{\partial s}ds\right)dA = -\left(p+\frac{\partial p}{\partial s}ds\right)\left(A+\frac{\partial A}{\partial s}ds\right)$$



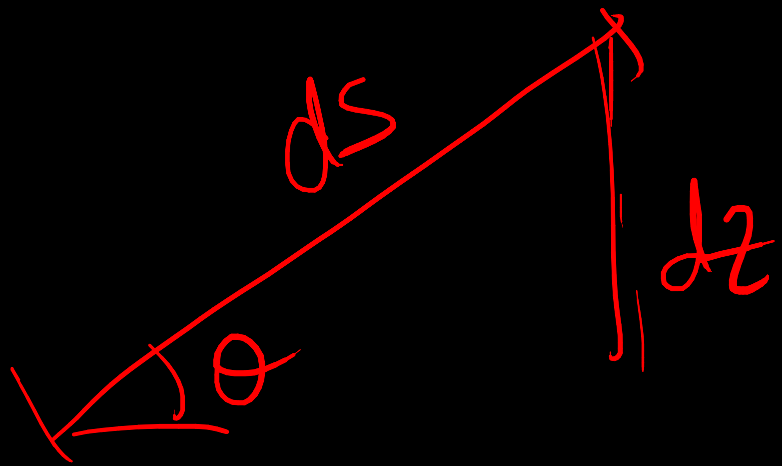
$$\int \underline{p_{s'}\, dA_{p_{s'}}} = \left(p+\frac{\partial p}{\partial s'}s'\right)$$

$ds' = ds$

$$\frac{A_{s'+\Delta s'} - A_{s'}}{} = \frac{\partial A}{\partial s'}ds'$$

$$\int_0^{ds}\left(p+\frac{\partial p}{\partial s'}s'\right)\left(\frac{\partial A}{\partial s'}ds'\right) = \int_0^{ds} p\frac{\partial A}{\partial s'}ds' + \int_0^{ds}\frac{\partial p}{\partial s'}\frac{\partial A}{\partial s'}s'ds'$$

$$= p\frac{\partial A}{\partial s'}ds + \frac{\partial p}{\partial s'}\frac{\partial A}{\partial s'}\frac{ds^2}{2}$$



$$\left(p + \frac{\partial p}{\partial s}\frac{ds}{2}\right)\frac{\partial A}{\partial s}ds = \left(p + \frac{\partial p}{\partial s}\frac{ds}{2}\right)\frac{\partial A}{\partial s}ds$$

$$\rho u\left(u + \frac{\partial u}{\partial s}ds\right)A - \rho u^2 A = \boxed{-\rho g \sin\theta\left(A + \frac{\partial A}{\partial s}\frac{ds}{2}\right)ds}\ \boxed{+pA - \left(p + \frac{\partial p}{\partial s}ds\right)\left(A + \frac{\partial A}{\partial s}ds\right)}\ \boxed{+\left(p + \frac{\partial p}{\partial s}\frac{ds}{2}\right)\left(\frac{\partial A}{\partial s}ds\right)}$$

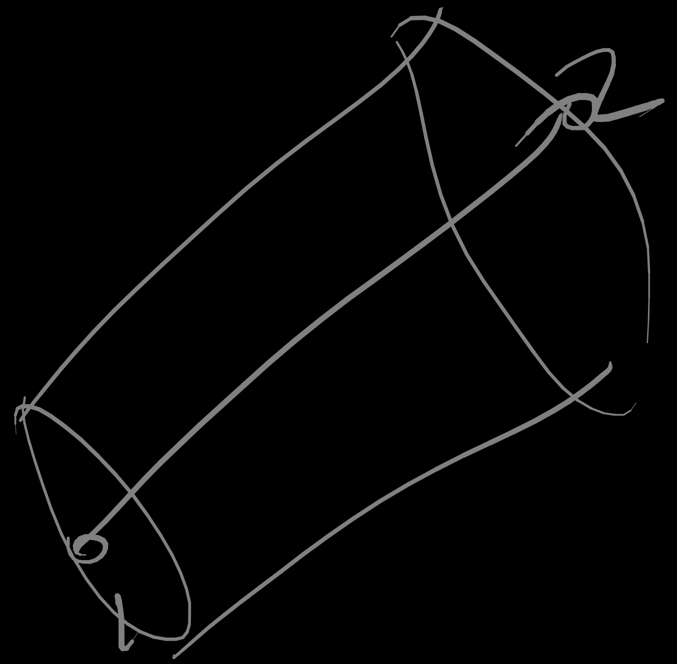
$$\rho u\frac{\partial u}{\partial s}ds\,A = -p\frac{\partial A}{\partial s}ds - \frac{\partial p}{\partial s}ds\,A - \cancelto{0}{\frac{\partial p}{\partial s}\frac{\partial A}{\partial s}ds^2} - \rho g A\,dz - \cancelto{0}{\rho g\frac{\partial A}{\partial s}\frac{ds}{2}dz}$$

$$p\frac{\partial A}{\partial s}ds + \cancel{\frac{\partial A}{\partial s}\frac{\partial p}{\partial s}\frac{ds^2}{2}} \to 0$$

$ds \to 0$

$$\rho U\frac{\partial U}{\partial s}ds\,A = -\frac{\partial p}{\partial s}ds\,A - \cancel{p\frac{\partial A}{\partial s}ds} - \rho g A\,dz$$

$$\cancel{+p\frac{\partial A}{\partial s}ds}$$

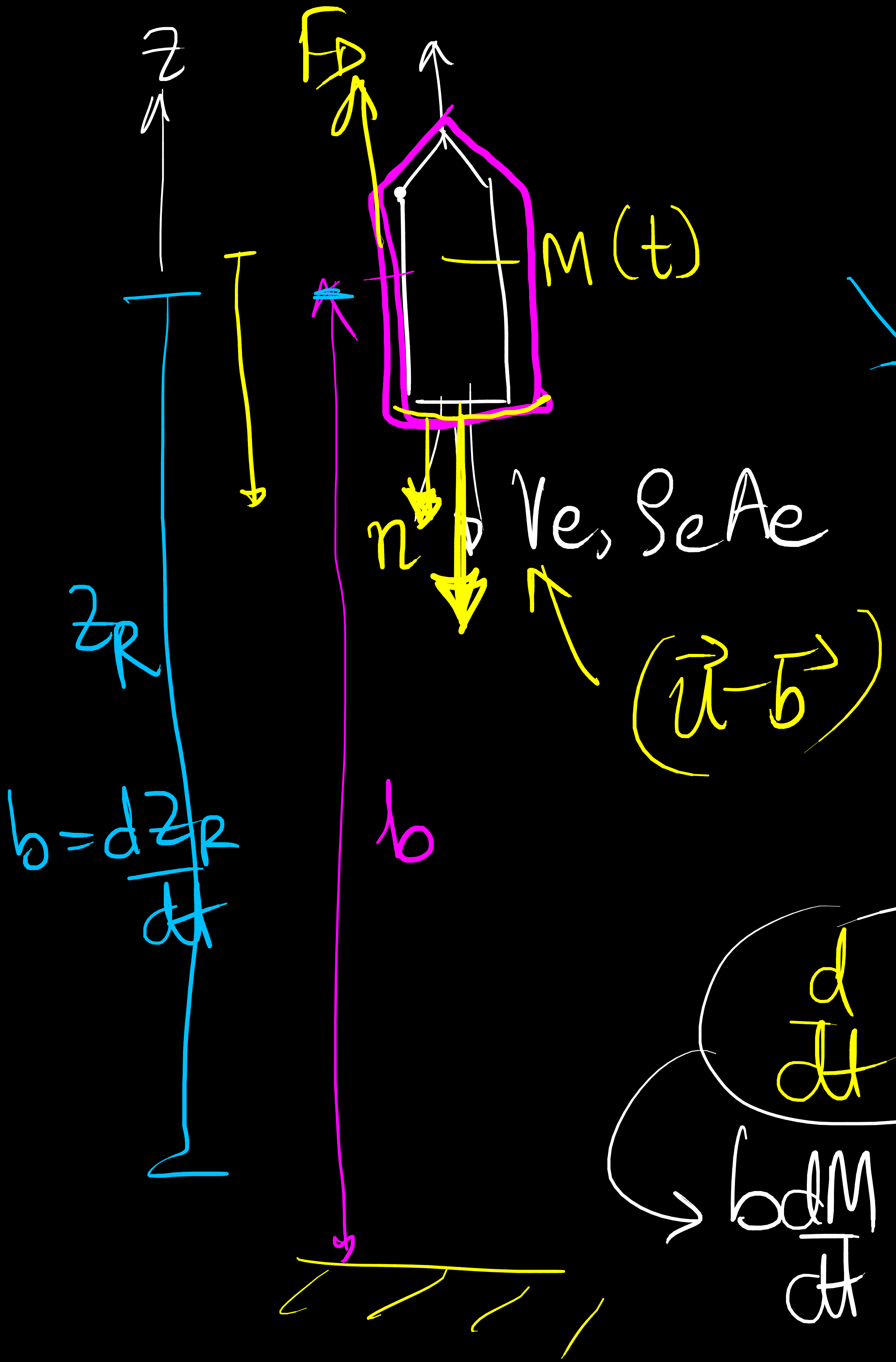


$$\int_1^2 U\frac{\partial U}{\partial s}ds = \int_1^2 -\frac{1}{\rho}\frac{\partial p}{\partial s}ds - \int_1^2 g\,dz$$

$$\left[\frac{U^2}{2}\right]_1^2 = -\frac{1}{\rho}(p_2-p_1) - g(z_2-z_1)$$

$$\boxed{\frac{U^2}{2} + p/\rho + gz = 0}$$

Bernoulli eqn



DE, motion

$\vec b = b\,\vec e_z$

$$\boxed{\begin{aligned}\vec V_{e,r} &= \vec V_{e,a} - \vec V_r\\ \vec V_e &= \vec V_{e,a} - \vec b\\ \vec V_{ea} &= \vec V_e + \vec b\\ &= -V_e\vec e_z + b\,\vec e_z\end{aligned}} = (b - V_e)\,\vec e_z$$

cons. mass

$$\frac{d}{dt}(M) + \int \rho(\vec u - \vec b)\cdot\vec n\,dA = 0$$

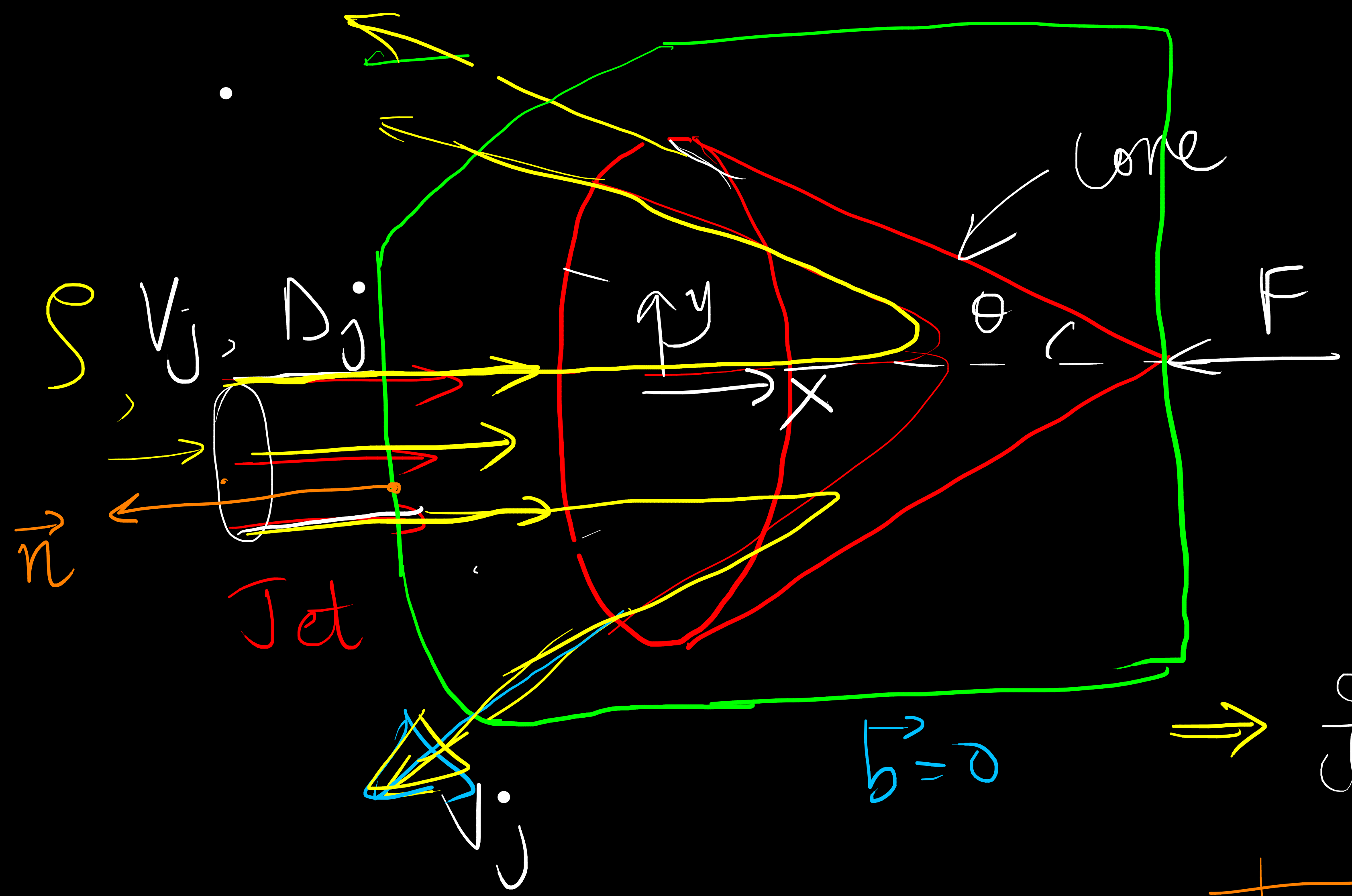
$$\boxed{\frac{dM}{dt} + \rho_e(V_e A_e) = 0}$$

$$\frac{d}{dt}(Mb) + \int \rho u_z(\vec u - \vec b)\cdot\vec n\,dA = -Mg + F_D$$

$$\frac{d}{dt}(Mb) + \rho(b - V_e)V_e A_e = -Mg + F_D$$

$$b\frac{dM}{dt} + M\frac{db}{dt} = M\frac{db}{dt} - \cancel{b\rho_e V_e A_e} + \cancel{\rho_e b V_e A_e} - \rho_e V_e^2 A_e$$

$$= M\frac{db}{dt} - \rho_e V_e^2 A_e = -Mg + F_D$$



CV : Force F

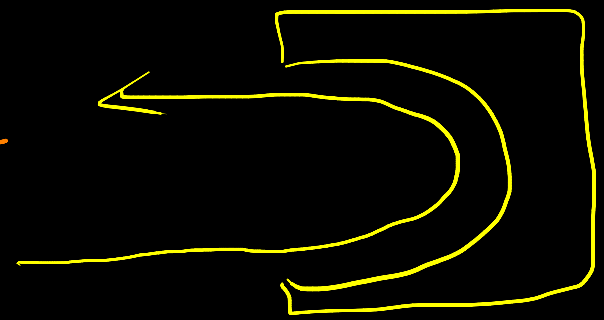
$$\frac{d}{dt}\int \cancel{\rho\, d\forall}^{\,0} + \int \rho \vec{u}\cdot\vec{n}\, dA = 0$$

$$\int_{in} \rho \vec{u}\cdot\vec{n}\, dA + \int_{exit} \rho \vec{u}\cdot\vec{n}\, dA = 0$$

$$-\rho V_j A_j + \dot{m}_{ext} = 0$$

$$\Rightarrow \frac{d}{dt}\int \cancel{\rho \vec{u}\, d\forall}^{\,0} + \int \rho \vec{u}\, \vec{u}\cdot\vec{n}\, dA = -F\vec{e}_x$$

$$\boxed{\rho V_j^2 A_j (1+\cos\theta) = F}$$

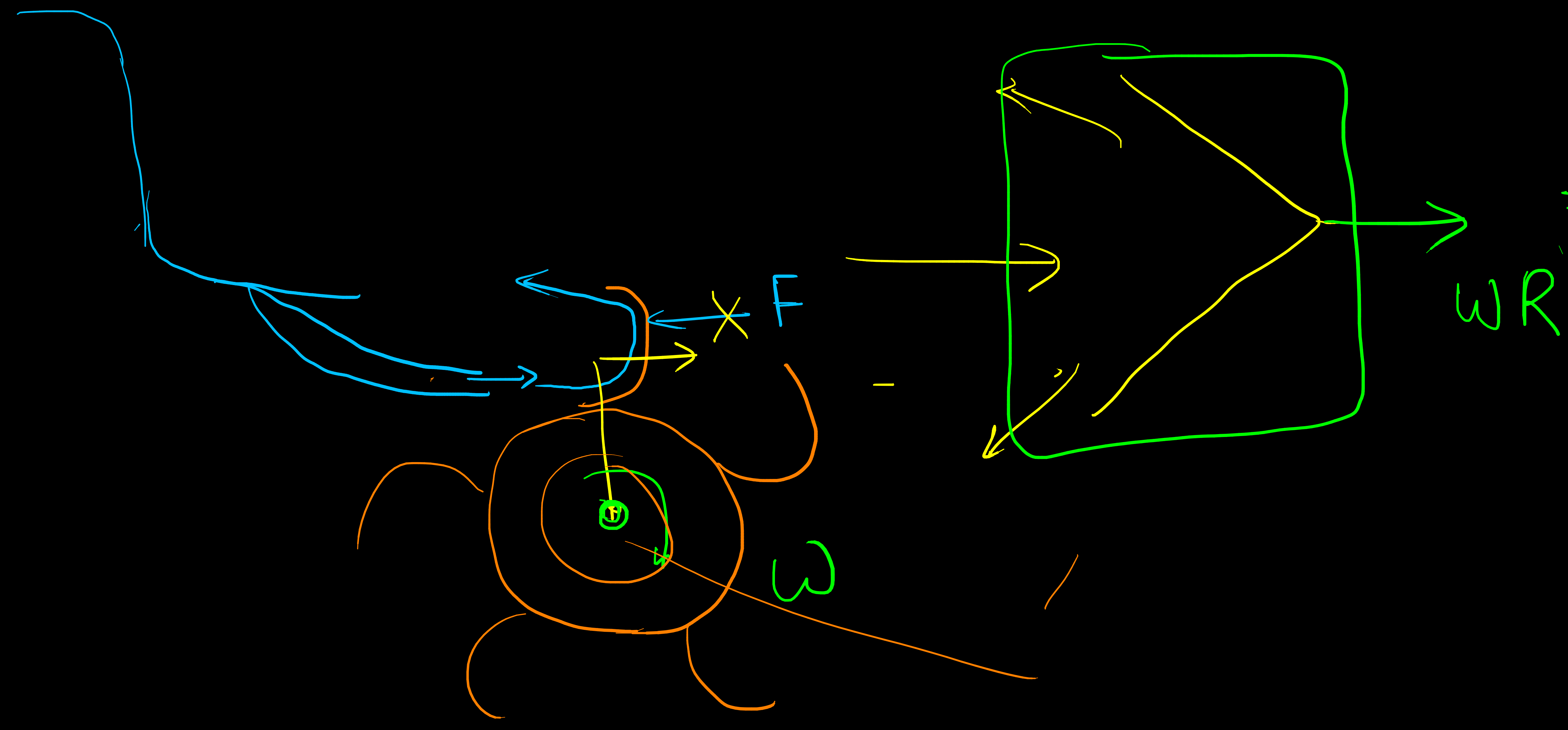


$$\int \rho u\, \vec{u}\cdot\vec{n}\, dA = -F$$

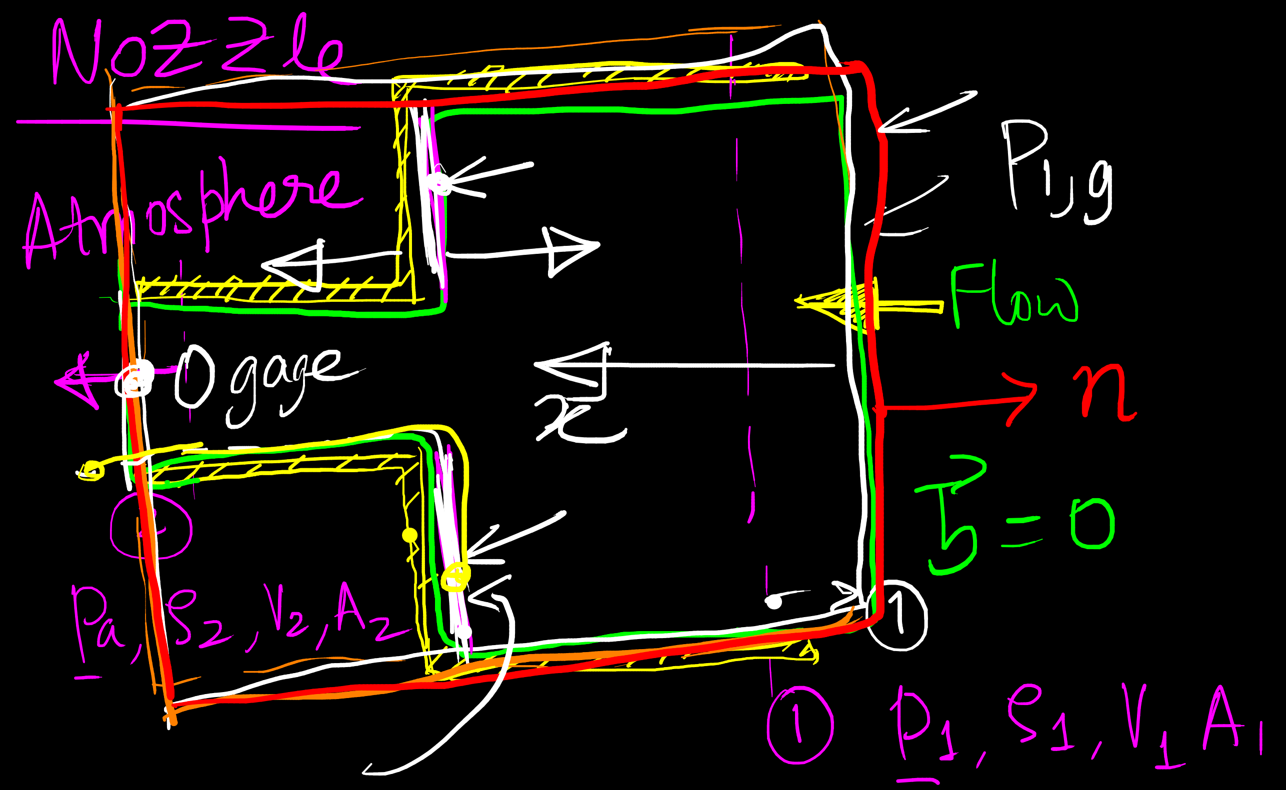
only

$$\rho V_j \times (-V_j A_j) + \int_{ext} \rho(-V_j \cos\theta)\, \vec{u}\cdot\vec{n}\, dA = -\rho V_j^2 A_j - V_j \cos\theta \times [\rho V_j A_j]$$

$$= -\rho V_j^2 A_j (1+\cos\theta)$$



$$\underline{\underline{\vec{b}}} \neq 0$$



Force by fluid on nozzle?

cons. mass

$$\int \rho \vec{u}\cdot\vec{n}\, dA = 0$$

$$\rho_1(-V_1A_1) + \rho_2V_2A_2 = 0$$

$$\rho_1V_1A_1 = \rho_2V_2A_2 = \dot{m}$$

cons. momentum

$$\int \rho u(\vec{u}\cdot\vec{n})\, dA = F_x$$

$$\boxed{P_1A_1 - P_aA_2}$$

$-P_a(\text{Rem ang})$

$$\rho_1V_1(-V_1A_1) + \rho_2V_2V_2A_2 = F_{cv} + \underline{P_{1,g}A_1}$$

$-P_a$ → ② $= 0$

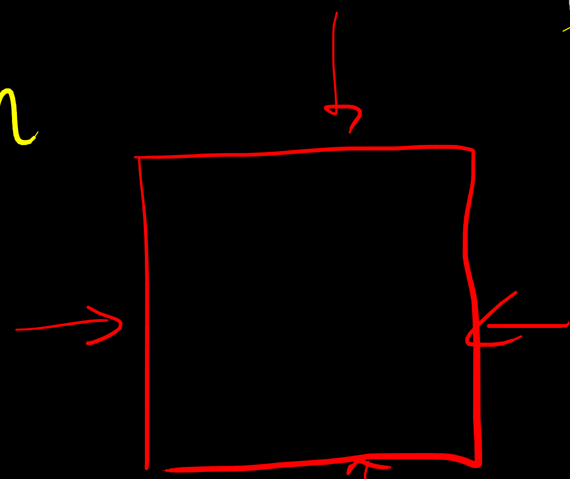
① $= P_{1,g} = P_1 - P_a$

$$F_{cv} = -P_{1,g}A_1 + \rho_2V_2^2A_2 - \rho_1V_1^2A_1$$

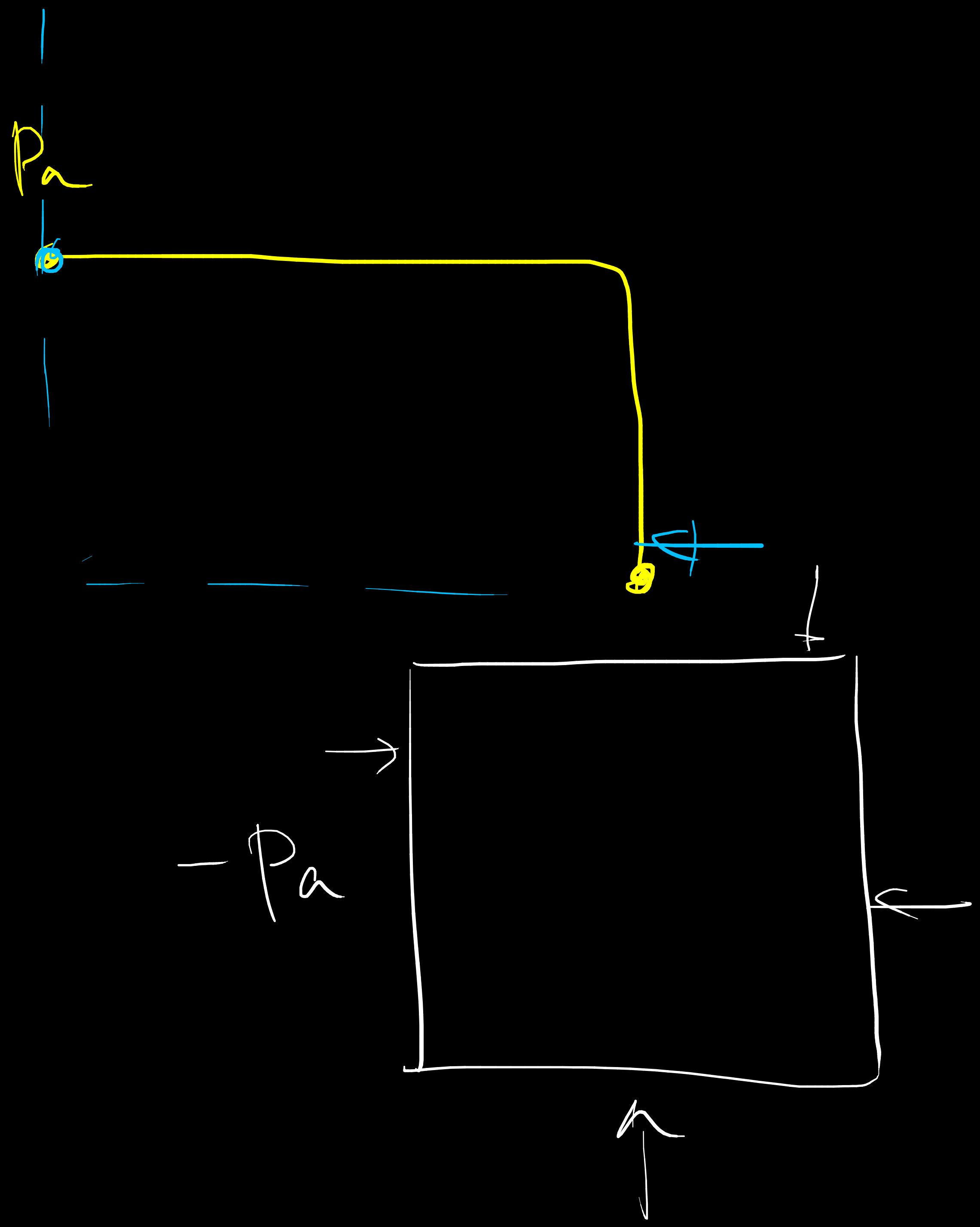
$$= -P_{1g}A_1 + V_2(\rho_2V_2A_2) - V_1(\rho_1V_1A_1)$$

$$\boxed{F_{cv} = -P_{1,g}A_1 + \dot{m}(V_2 - V_1)}$$ ✓

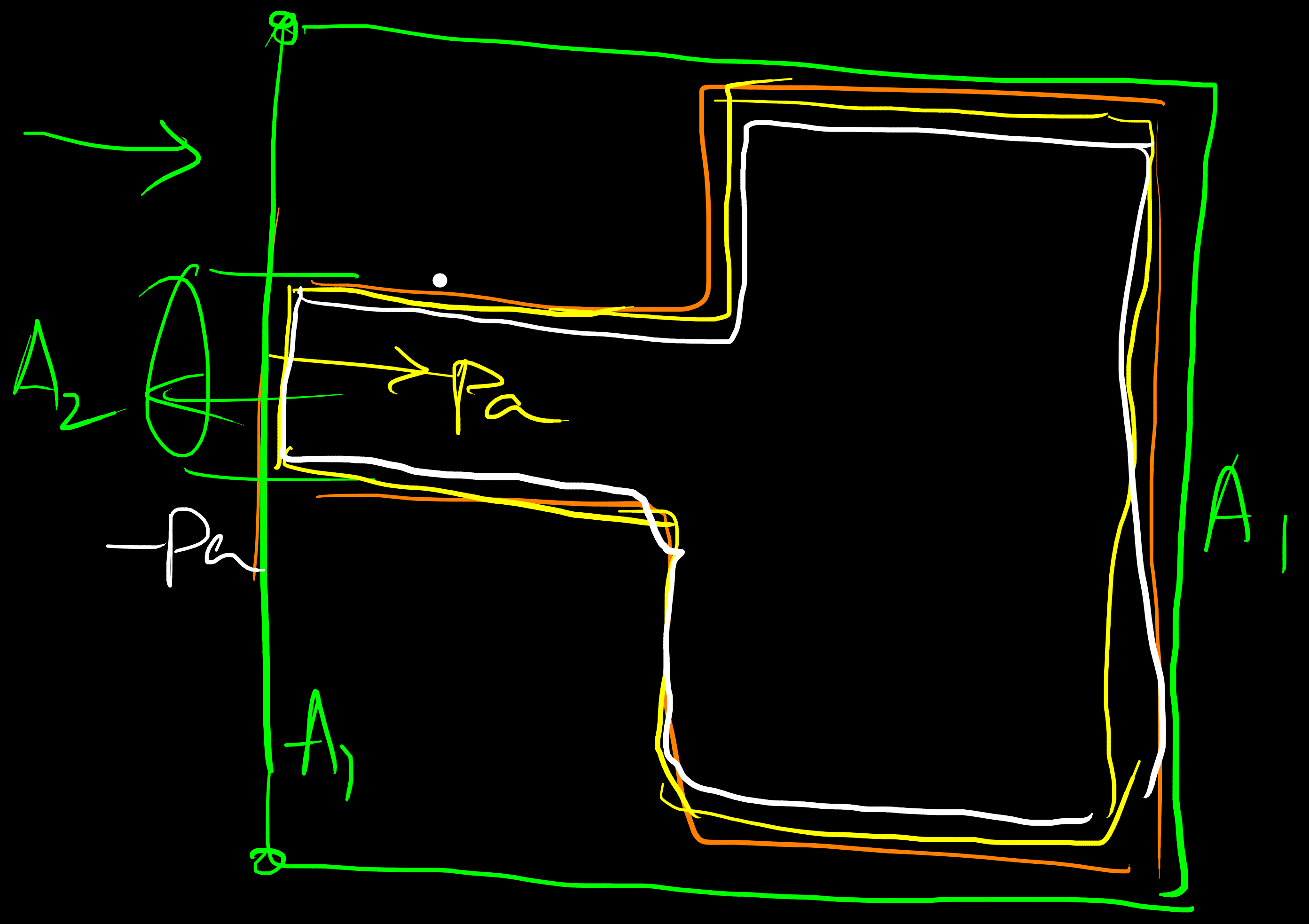
$$-P_{1g}A_1 + \underbrace{\dot{m}(V_2 - V_1)}$$



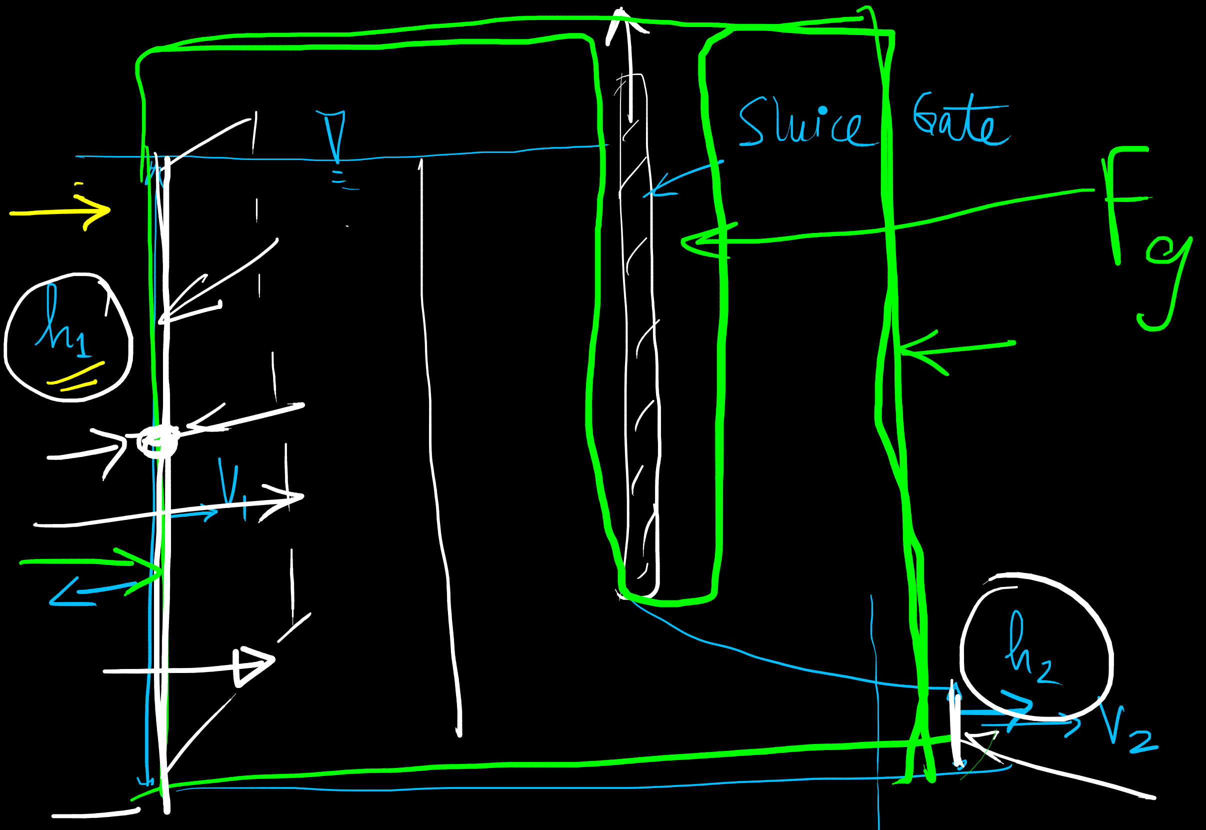
$(-P_a)$ ✓



Pa
-Pa



A2
Pa
-Pa
A1
A1



CV : F_G p_e p_r

Stationary

F_{gf} F

$-F_{CV}$

$-F_{CV} + F = 0$

$F = F_{CV}$

statics for gate

$$\to \cancel{\frac{d}{dt}\int \rho \, d\forall}^{\,0} + \int \rho \vec{u}\cdot\vec{n}\, dA = 0$$

$F_{gf} - F = 0$ X

$$-\rho V_1 h_1 W + \rho V_2 h_2 W = 0$$

$$V_1 h_1 = V_2 h_2$$

$$\frac{V_1}{V_2} = \frac{h_2}{h_1}$$

$$\frac{h_1}{h_2} = \frac{V_2}{V_1}$$

$$\cancel{\frac{d}{dt}\int \rho \vec{u}\, d\forall}^{\,0} + \int \rho \vec{u}\, \vec{u}\cdot\vec{n}\, dA = F + F_p \leftarrow \text{Hydrostatics}$$

$$-\rho V_1^2 h_1 W + \rho V_2^2 h_2 W = F_{CV} + \frac{1}{2} h_1 W \rho g h_1 - \frac{1}{2} h_2 W \rho g h_2$$

$$F = \rho V_2^2 h_2 W \left[1 - \frac{V_2^2}{V_1^2}\frac{h_1}{h_2}\right] + \frac{1}{2} h_2 W \rho g h_2 \left(1 - \frac{h_1^2}{h_2^2}\right) \quad \left(\frac{h_1}{h_2}\right)?$$

$$F = \rho V_2^2 h_2 W \left[1 - \frac{V_2^3}{V_1^3}\right] + \frac{1}{2} W \rho g h_2^2 \left(1 - \frac{V_2^2}{V_1^2}\right)$$

$$\partial F / \partial(\bar{h}) =$$

$$\Rightarrow \boxed{V_1^2 << g h_1} \leftarrow \text{Press force dominates momentum flux}$$