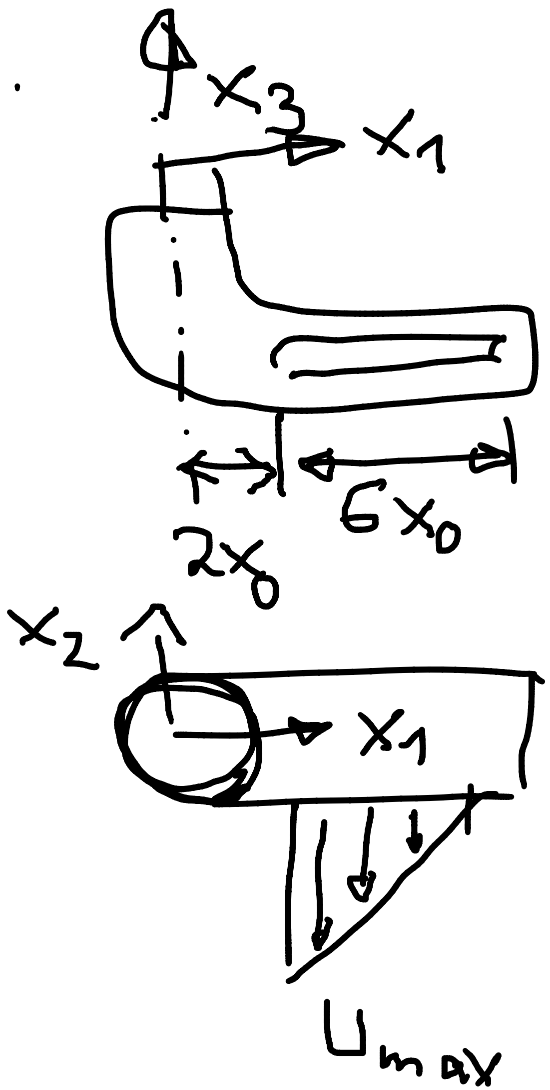


$$U = U_{max}\,\frac{(8x_0 - x_1)}{6x_0}$$

stationärer Drallsatz

$$\int_S (\vec{r} \times \rho \vec{u})\, \vec{u} \cdot \vec{n}\, dS = \vec{M}_{R \to F}$$

$$\vec{r} \times \rho \vec{u} = (x_1 \vec{e}_1) \times (-\rho U \vec{e}_2)$$

$$= -\rho x_1 U \vec{e}_3$$

$$\vec{M}_{R \to F} = b \int_{2x_0}^{8x_0} -\rho x_1 U^2 \, dx_1 \; \vec{e}_3$$

$$\vec{M}_{F \to R} = b \rho \int_{2x_0}^{8x_0} x_1 \frac{U_{max}^2}{(6x_0)^2} (8x_0 - x_1)^2 \, dx_1 \; \vec{e}_3$$

$$= \frac{b \rho U_{max}^2}{36 x_0^2} \int_{2x_0}^{8x_0} x_1 (8x_0 - x_1)^2 \, dx_1 \; \vec{e}_3$$

$$= \varrho \frac{U_{max}^2}{36\, x_0^2} b \int_{2x_0}^{8x_0} 64\, x_0^2\, x_1 - 16\, x_0 x_1^2 + x_1^3 \, dx_1$$

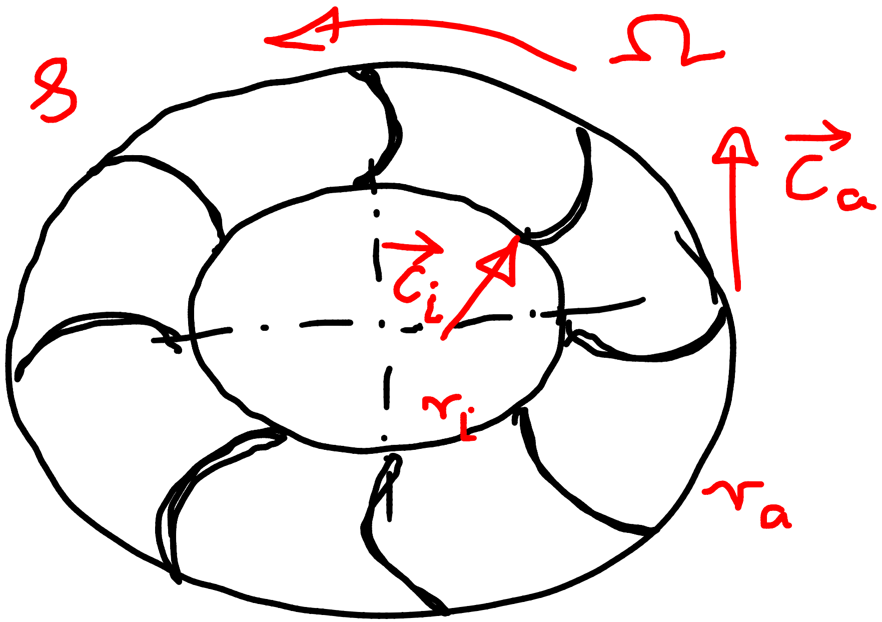
$$= \varrho \frac{U_{max}^2}{36\, x_0^2} b \left[64\, x_0^2 \frac{x_1^2}{2} - \frac{16}{3} x_0 x_1^3 + \frac{x_1^4}{4} \right]_{2x_0}^{8x_0} =$$

$$\underline{\underline{7 \varrho b\, U_{max}^2\, x_0^2}}$$

$$\underline{Q = \int_S \vec{u} \cdot \vec{n}\, dS} = b \int_{2x_0}^{8x_0} \frac{U_{max}}{6x_0} (8x_0 - x_1)\, dx_1$$

$$= \frac{U_{max}}{2} \cdot b \cdot 6x_0 = 3 b x_0 U_{max}$$

$$\underline{\underline{U_{max} = \frac{Q}{3 b x_0}}}$$



$$\int_S \vec{r} \times \rho \vec{c} \; \underbrace{\vec{c} \cdot \vec{n} \, dS}_{dQ}$$

$$\vec{e}_r \times \vec{e}_u = \vec{e}_z$$

$$r_i \vec{e}_r \times \rho \left(c_{ir} \vec{e}_r + c_{iu} \vec{e}_u \right) = \rho r_i c_{iu} \vec{e}_z$$

$$Q = 2\pi r_i c_{ir}$$

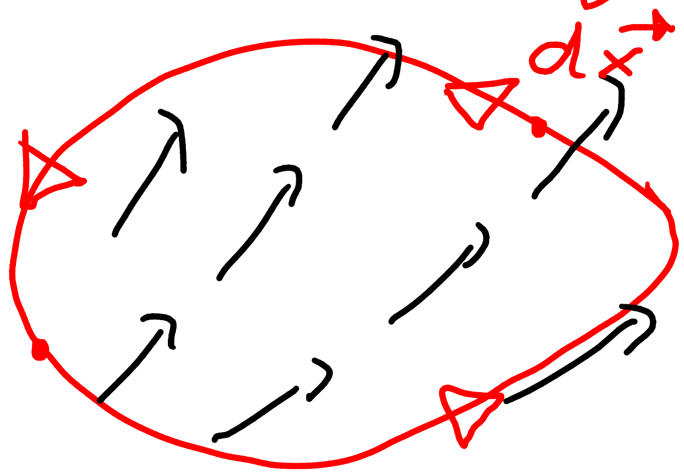
$$M_z = \rho\, r_a c_{ua} (+Q) + \rho\, r_i c_{ui} (-Q)$$

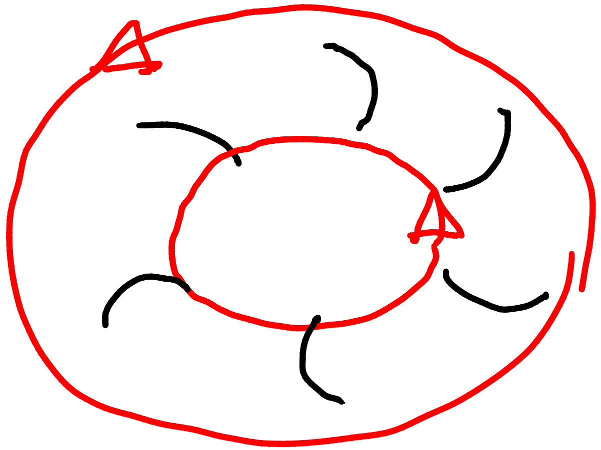
$\dot m$

$$= \underline{\underline{\dot m \left(r_a c_{ua} - r_i c_{ui} \right)}}$$

Eulersche Turbinen-gleichung

$$\Gamma = \oint \vec{c} \cdot d\vec{x}$$





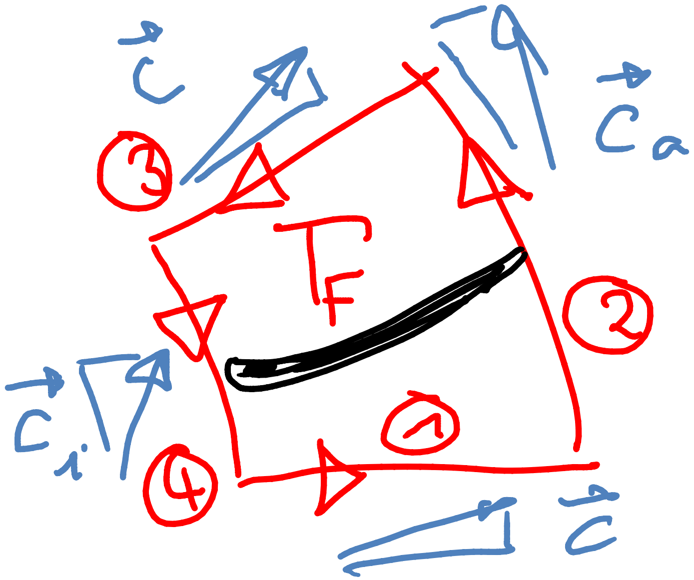
$$\Gamma_i = \oint \vec{c}_i \cdot d\vec{x}$$

$$= c_{ui}\, 2\pi\, r_i$$

$$\Gamma_a = \oint \vec{c}_a \cdot d\vec{x} = \boxed{c_{ua}\, 2\pi\, r_a}$$

$$M_z = \dot{m}\left(r_a c_{ua} - r_i c_{ui}\right)$$

$$= \frac{\dot{m}}{2\pi}\left[\Gamma_a - \Gamma_i\right]$$

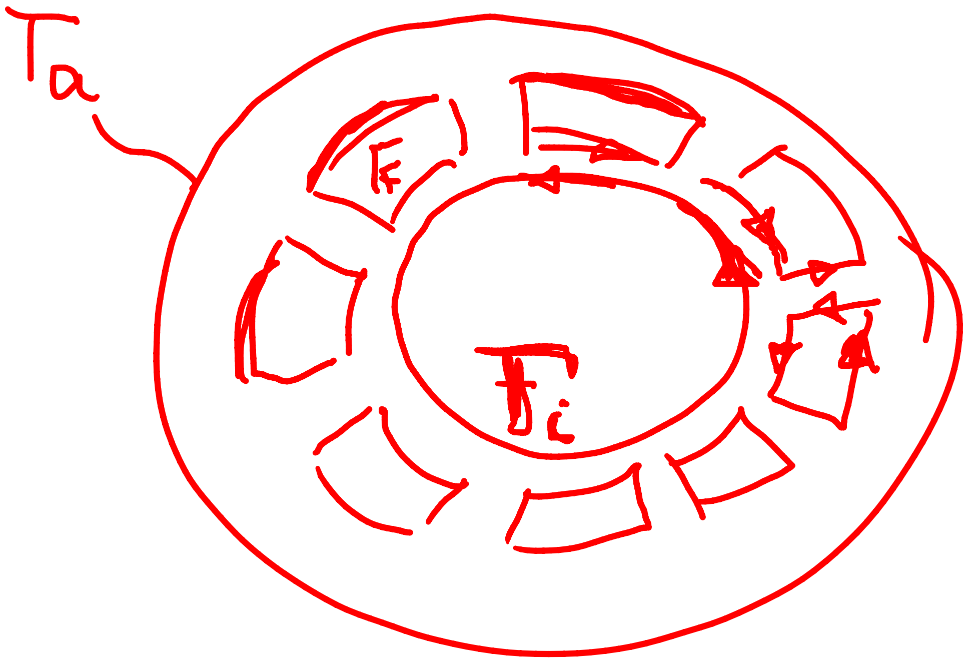


$$T_F = \cancel{\underbrace{\int_{r_i}^{r_a} c_r \, dr}_{1}} + \underbrace{\int_0^{2\pi/n} c_{ua} \, r \, d\varphi}_{2} + \cancel{\underbrace{\int_{r_a}^{r_i} c_r \, dr}_{3}} + \int_{2\pi/n}^{0} c_{ui} \, r \, d\varphi =$$

$$\int_7^1 1 \, dx = \Big[x \Big]_7^1 = 1 - 7 = -6$$

$$T_F = \frac{2\pi}{n} \left(c_{ua} r_a - c_{ui} r_i \right)$$

$$T_a = T_i + n T_F$$



TECHNISCHE UNIVERSITÄT DARMSTADT

FLUID SYSTEM TECHNIK

Einführung in die Hydrodynamik
Vorrechenübung