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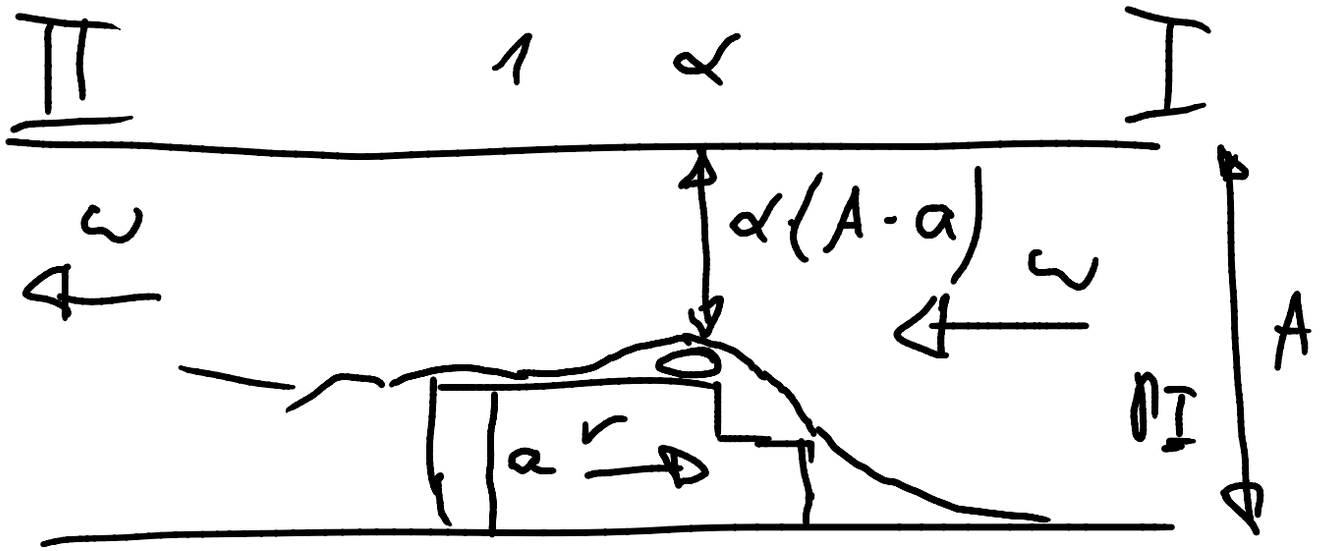
TECHNISCHE UNIVERSITÄT DARMSTADT

FLUID SYSTEM TECHNIK

Prof. Dr. Ing. Peter Pelz
Sommersemester 2010
Strömungslehre für Mechatronik
Vorrechenübung 6



$$p_I + \frac{\rho}{2}\omega_I^2 = p_{II} + \frac{\rho}{2}\omega_{II}^2 + \Delta p_v$$

$$\Delta p_v = \sum \Delta p_{v,\text{carnod}} = \frac{\rho}{2}(\omega_a - \omega_1)^2 + \frac{\rho}{2}(\omega_1 - \omega)^2$$

$$p_I - p_{II} = \Delta p_v$$

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Konti:

$$\omega \cdot A = \omega_\alpha \cdot \alpha (A-a) = \omega_1 (A-a)$$

$$\omega_\alpha = \omega \cdot \frac{A}{\alpha (A-a)}$$

$$\omega_1 = \omega \cdot \frac{A}{A-a}$$

$$p_I - p_{II} = \frac{\rho}{2} \left(\omega \frac{A}{\alpha (A-a)} - \omega \frac{A}{(A-a)} \right)^2 +$$

$$\frac{\rho}{2} \left(\omega \cdot \frac{A}{(A-a)} - \omega \right)^2$$

$$= \frac{\rho}{2} \omega^2 \underbrace{\left[\left(\frac{A(1-\alpha)}{\alpha (A-a)} \right)^2 + \left(\frac{a}{A-a} \right)^2 \right]}_{b} \quad (1)$$

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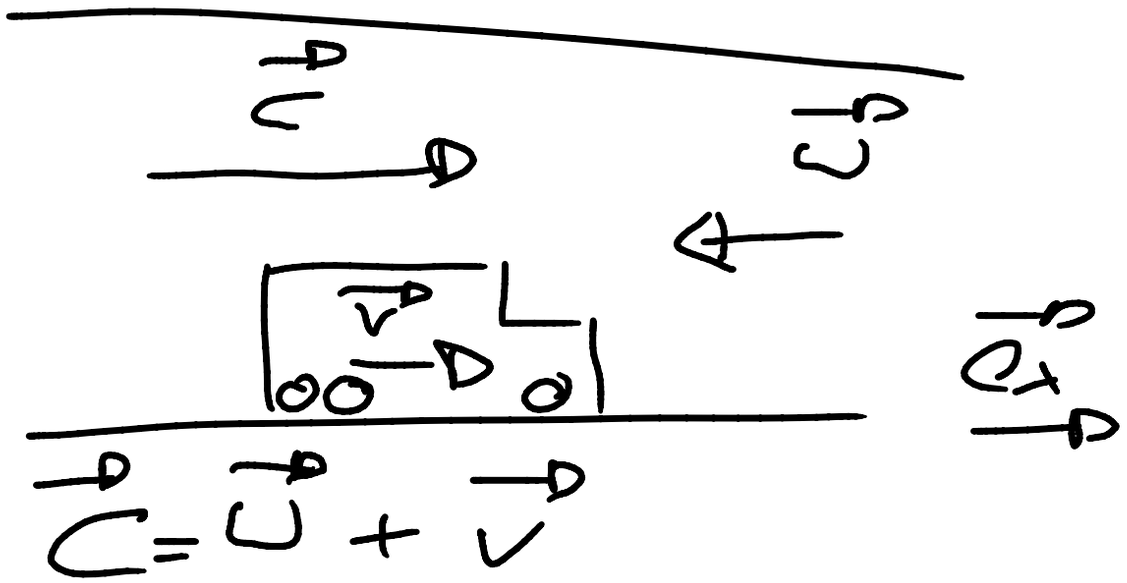

$$\vec{c} = \vec{u} + \vec{v}$$

$$\vec{c} \cdot \vec{e}_x = \omega \cdot (-\vec{e}_x) + v \cdot \vec{e}_x$$

$$\boxed{\omega \vec{e}_x = (v - c)\vec{e}_x}$$

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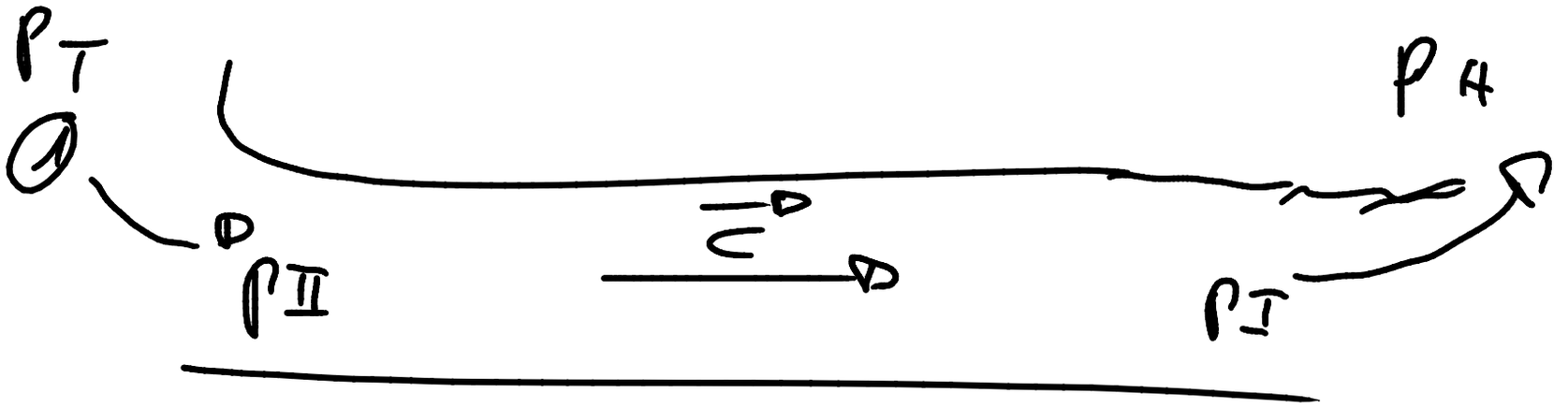
b)



$$p_T = \frac{\rho}{2} c^2 + p_{II}$$

$$p_{II} = p_T - \frac{\rho}{2} c^2 \quad (2) \quad \frac{\rho}{2}(c-0)^2$$

$$p_I + \frac{\rho}{2} c^2 = p_H + \Delta p_L$$

$$p_I = p_H \quad (3)$$

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c) ③, ② → ①

$$p_I - p_{II} = \frac{\rho}{2} c^2 b$$

$$p_H - p_T + \frac{\rho}{2} c^2 = \frac{\rho}{2}(v-c)^2 b$$

$$= \frac{\rho}{2} v^2 b - \rho \cdot v \cdot c b + \frac{\rho}{2} c^2 b \quad (4)$$

$$0 = \frac{\rho}{2} v^2 b - \rho v c b + \frac{\rho}{2} c^2 b - p_H + p_T - \frac{\rho}{2} c^2$$

$$0 = \frac{\rho}{2} c^2 (b-1) - \rho v c b + \frac{\rho}{2} v^2 b + p_T - p_H$$

$$0 = c^2 - \frac{2 v c b}{b-1} + v^2 \frac{b}{b-1} + \frac{2(p_T - p_H)}{\rho(b-1)}$$

$$c_{1/2} = \frac{vb}{b-1} \pm \sqrt{\left(\frac{vb}{b-1}\right)^2 - \frac{v^2 b}{b-1} - \frac{2(p_T - p_H)}{\rho(b-1)}}$$

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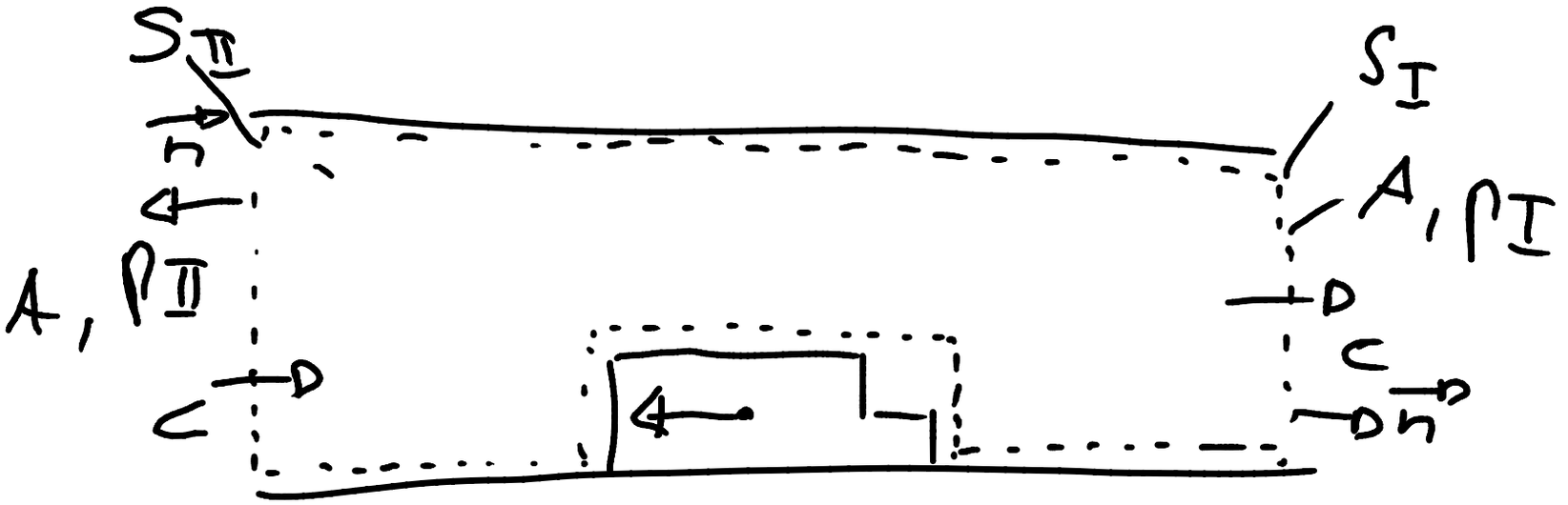

$$\iint_S \rho \vec{u}(\vec{u}\cdot\vec{n})\,dS = \iint_S \vec{t}\,dS$$

$$0 = \iint_S \vec{t}\,dS$$

$$0 = -\iint_{S_{II}} \vec{t}\,dS + \iint_{S_I} \vec{t}\,dS + \underbrace{\iint_{S_K} \vec{t}\,dS}_{-F}$$

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$$F = -\iint_{S_{II}} \vec{\epsilon}\, dS + \iint_{S_I} \vec{\epsilon}\, dS$$

$$= -p_{II} A + p_I A$$

$$F = A(p_I - p_{II})$$

$$F = A\left(p_H - p_T + \frac{\rho}{2} c^2\right)$$

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$$p_H - p_T + \frac{\rho}{2}c^2 = \frac{\rho}{2}v^2 b - \rho v c b + \frac{\rho}{2}c^2 b$$

$$\downarrow$$

$$c \doteq 0$$

$$p_H - p_T = \frac{\rho}{2}v^2 b$$

$$v = \sqrt{\frac{2 \cdot (p_H - p_T)}{\rho \cdot b}}$$

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