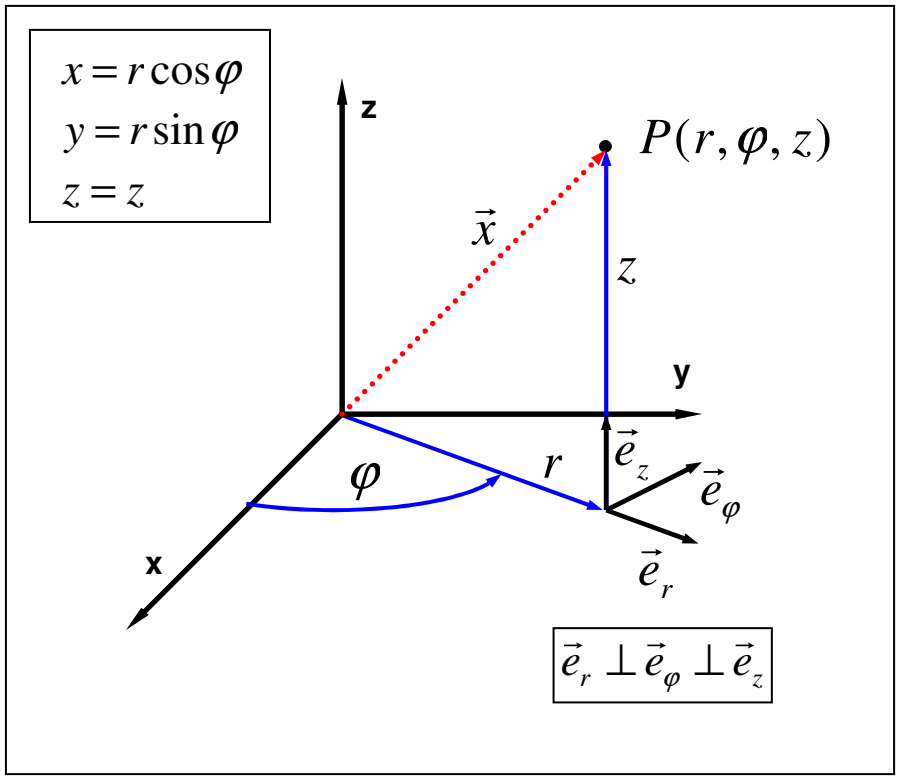
EINFÜHRUNG IN DIE ZYLINDERKOORDINATEN (vgl. Anhang)

Ortsvektor

$$\vec{x} = r\vec{e}_r + z\vec{e}_z$$



Einheitsvektoren

$$\vec{e}_r = +\cos\varphi\vec{e}_x + \sin\varphi\vec{e}_y$$
$$\vec{e}_\varphi = -\sin\varphi\vec{e}_x + \cos\varphi\vec{e}_y$$
$$\vec{e}_z = \vec{e}_z$$

Geschwindigkeitsvektor

$$\vec{u} = u_r\vec{e}_r + u_\varphi\vec{e}_\varphi + u_z\vec{e}_z$$

Linienelement

$$d\vec{x} = \frac{\partial\vec{x}}{\partial r}dr + \frac{\partial\vec{x}}{\partial\varphi}d\varphi + \frac{\partial\vec{x}}{\partial z}dz = \frac{\partial(r\vec{e}_r + z\vec{e}_z)}{\partial r}dr + \frac{\partial(r\vec{e}_r + z\vec{e}_z)}{\partial\varphi}d\varphi + \frac{\partial(r\vec{e}_r + z\vec{e}_z)}{\partial z}dz =$$

$$= \vec{e}_r dr\frac{\partial r}{\partial r} + rd\varphi\frac{\partial\vec{e}_r}{\partial\varphi} + \vec{e}_z dz\frac{\partial z}{\partial z} = \vec{e}_r dr + rd\varphi\frac{\partial(\cos\varphi\vec{e}_x + \sin\varphi\vec{e}_y)}{\partial\varphi} + \vec{e}_z dz =$$

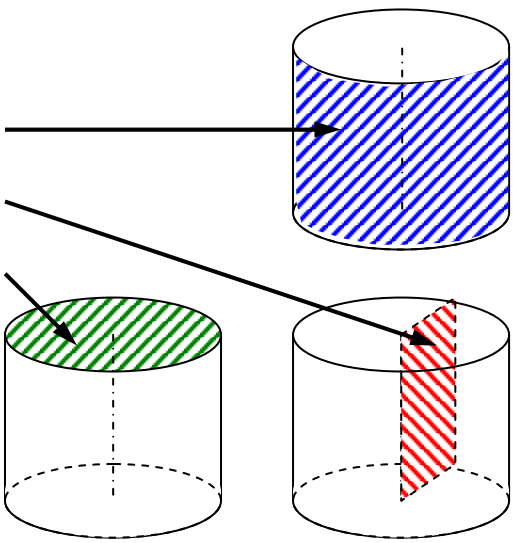
$$= \vec{e}_r dr + rd\varphi(-\sin\varphi\vec{e}_x + \cos\varphi\vec{e}_y) + \vec{e}_z dz = \vec{e}_r dr + \vec{e}_\varphi rd\varphi + \vec{e}_z dz$$

Flächenelement

Zylindermantel ($r = konst.$) $\quad dS_r = rd\varphi dz$

Schnittfläche ($\varphi = konst.$) $\quad dS_\varphi = drdz$

Deckelfläche ($z = konst.$) $\quad dS_z = rdrd\varphi$



Volumenelement

$$dV = rdrd\varphi dz$$