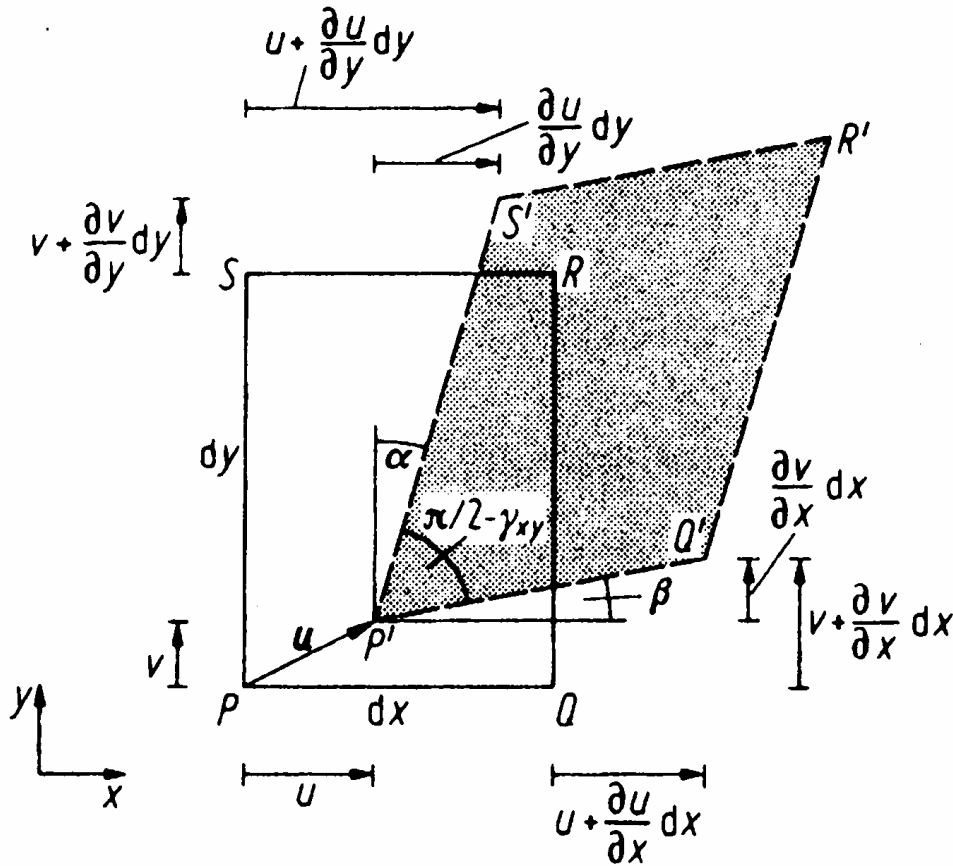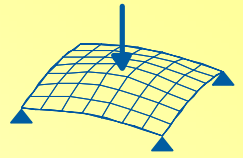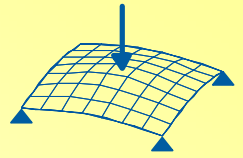$$\varepsilon_x = \frac{P'Q' - PQ}{PQ} = \frac{\partial u}{\partial x}$$

$$\varepsilon_y = \frac{P'S' - PS}{PS} = \frac{\partial v}{\partial y}$$

$$\gamma_{xy} = \alpha + \beta = \frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}$$

Ebener Verzerrungszustand:

$$\boldsymbol{\varepsilon} = \begin{bmatrix} \varepsilon_x & \dfrac{1}{2}\gamma_{xy} \\[2ex] \dfrac{1}{2}\gamma_{xy} & \varepsilon_y \end{bmatrix}$$
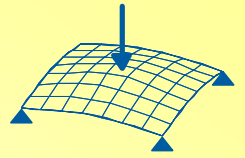
Räumlicher Verformungszustand:

$$\boldsymbol{\varepsilon} = \begin{bmatrix} \varepsilon_x & \dfrac{1}{2}\gamma_{xy} & \dfrac{1}{2}\gamma_{xz} \\[2ex] \dfrac{1}{2}\gamma_{xy} & \varepsilon_y & \dfrac{1}{2}\gamma_{yz} \\[2ex] \dfrac{1}{2}\gamma_{xz} & \dfrac{1}{2}\gamma_{yz} & \varepsilon_z \end{bmatrix}$$

$$\varepsilon_x = \frac{\partial u}{\partial x}, \qquad \varepsilon_y = \frac{\partial v}{\partial y}, \qquad \varepsilon_z = \frac{\partial w}{\partial z},$$

$$\gamma_{xy} = \frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}, \qquad \gamma_{xz} = \frac{\partial u}{\partial z} + \frac{\partial w}{\partial x},$$

$$\gamma_{yz} = \frac{\partial v}{\partial z} + \frac{\partial w}{\partial y}$$

Transformationsbeziehungen

$$\varepsilon_{\xi} = \frac{1}{2}\left(\varepsilon_x + \varepsilon_y\right) + \frac{1}{2}\left(\varepsilon_x - \varepsilon_y\right)\cos(2\varphi) + \frac{1}{2}\gamma_{xy}\sin(2\varphi)$$

$$\varepsilon_{\eta} = \frac{1}{2}\left(\varepsilon_x + \varepsilon_y\right) - \frac{1}{2}\left(\varepsilon_x - \varepsilon_y\right)\cos(2\varphi) - \frac{1}{2}\gamma_{xy}\sin(2\varphi)$$

$$\frac{1}{2}\gamma_{\xi\eta} = -\frac{1}{2}\left(\varepsilon_x - \varepsilon_y\right)\sin(2\varphi) + \frac{1}{2}\gamma_{xy}\cos(2\varphi)$$

Hauptdehnungen:

$$\varepsilon_{1,2} = \frac{\varepsilon_x + \varepsilon_y}{2} \pm \sqrt{\left(\frac{\varepsilon_x - \varepsilon_y}{2}\right)^2 + \left(\frac{1}{2}\gamma_{xy}\right)^2}$$

$$\tan(2\varphi^*) = \frac{\gamma_{xy}}{\varepsilon_x - \varepsilon_y}$$