

es gilt

$$\sigma_m = \frac{\sigma_1 + \sigma_2}{2} = \frac{\sigma_{max} + \sigma_{min}}{2}$$

$$\rightarrow \tau_{max} = + \sqrt{\left(\frac{\sigma_1 - \sigma_2}{2}\right)^2 + \tau^2} = \frac{\sigma_{max} - \sigma_{min}}{2}$$

$$\rightarrow \sigma_{max} = \sigma_m + \tau_{max} = \frac{\sigma_1 + \sigma_2}{2} + \sqrt{\frac{(\sigma_1 - \sigma_2)^2}{4} + \tau^2}$$

$$\rightarrow \sigma_{min} = \sigma_m - \tau_{max} = \frac{\sigma_1 + \sigma_2}{2} - \sqrt{\frac{(\sigma_1 - \sigma_2)^2}{4} + \tau^2}$$

$$\rightarrow \tan(2\varphi) = \frac{\tau}{\left(\frac{\sigma_1 - \sigma_2}{2}\right)} = \frac{2\tau}{\sigma_1 - \sigma_2} \rightarrow 2\varphi \rightarrow \varphi$$