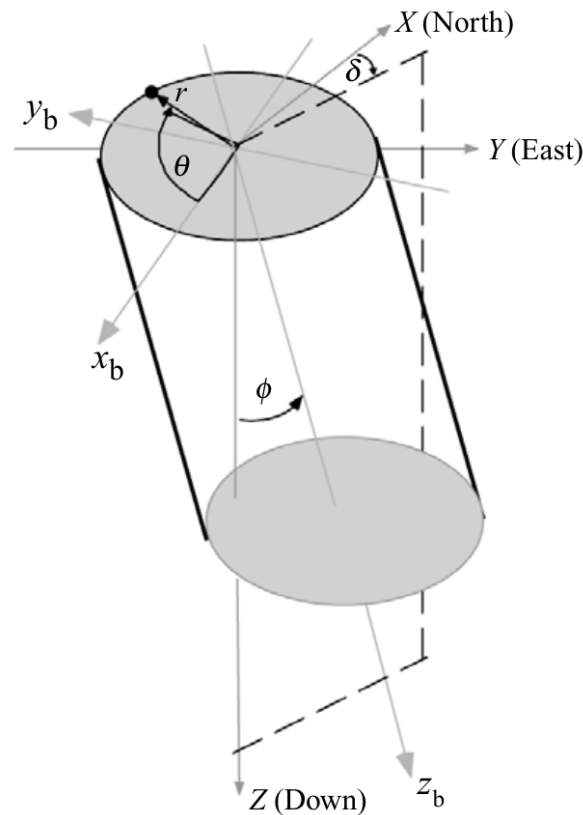


State of stress surrounding an arbitrarily deviated well



Stresses in the wellbore coordinate system

$$\mathbf{R}_B = \begin{bmatrix} \cos \delta \cos \phi & \sin \delta \cos \phi & -\sin \phi \\ -\sin \delta & \cos \delta & 0 \\ \cos \delta \sin \phi & \sin \delta \sin \phi & \cos \phi \end{bmatrix}$$

$$\mathbf{S}_B = \mathbf{R}_B \mathbf{S}_G \mathbf{R}_B^T$$

$$\mathbf{S}_B = \mathbf{R}_B (\mathbf{R}_G^T \mathbf{S} \mathbf{R}_G) \mathbf{R}_B^T$$

Stress at wellbore wall

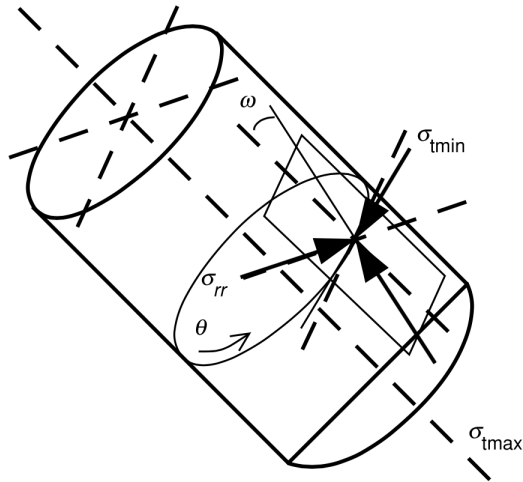
$$\sigma_{zz} = \sigma_{33} - 2\nu(\sigma_{11} - \sigma_{22}) \cos 2\theta - 4\nu\sigma_{12} \sin 2\theta$$

$$\sigma_{\theta\theta} = \sigma_{11} + \sigma_{22} - 2(\sigma_{11} - \sigma_{22}) \cos 2\theta - 4\sigma_{12} \sin 2\theta - \Delta P$$

$$\tau_{\theta z} = 2(\sigma_{23} \cos \theta - \sigma_{13} \sin \theta)$$

$$\sigma_{rr} = \Delta P$$

Principal effective stresses around the wellbore

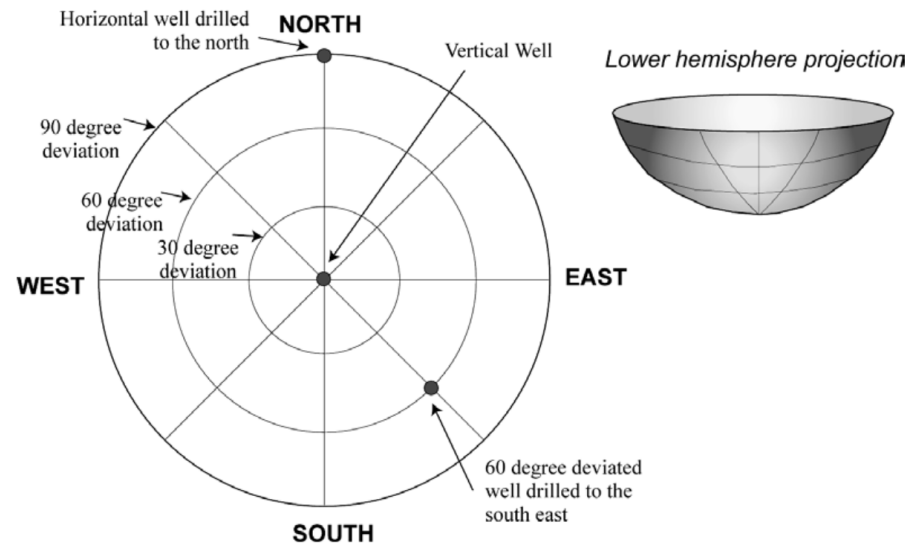


$$\sigma_{t\max} = \frac{1}{2} \left(\sigma_{zz} + \sigma_{\theta\theta} + \sqrt{(\sigma_{zz} - \sigma_{\theta\theta})^2 + 4\tau_{\theta z}^2} \right)$$

$$\sigma_{t\min} = \frac{1}{2} \left(\sigma_{zz} + \sigma_{\theta\theta} - \sqrt{(\sigma_{zz} - \sigma_{\theta\theta})^2 + 4\tau_{\theta z}^2} \right)$$

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Lower hemisphere projection



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Example

