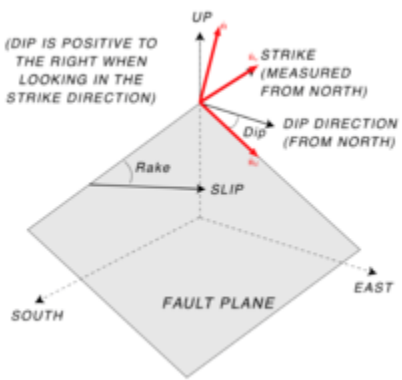
Fault orientation



 Zoback, *Reservoir Geomechanics* (Fig. 5.5, pp. 150)

$$\hat{\mathbf{n}} = \begin{bmatrix} -\sin(strike)\sin(dip) \\ \cos(strike)\sin(dip) \\ -\cos(dip) \end{bmatrix} \quad \hat{\mathbf{n}}_s = \begin{bmatrix} \cos(strike) \\ \sin(strike) \\ 0 \end{bmatrix} \quad \hat{\mathbf{n}}_d = \begin{bmatrix} -\sin(strike)\cos(dip) \\ \cos(strike)\cos(dip) \\ \sin(dip) \end{bmatrix}$$

Fault traction and stress

Traction on fault plane

$$\vec{t} = \mathbf{S}_G \cdot \hat{\mathbf{n}}$$

Normal stress to plane

$$S_n = \vec{t}^{\mathsf{T}} \cdot \hat{\mathbf{n}}$$

Shear stress in dip direction

$$\tau_d = \vec{t}^{\mathsf{T}} \cdot \hat{\mathbf{n}}_d$$

Shear stress in strike direction

$$\tau_s = \vec{t}^{\mathsf{T}} \cdot \hat{\mathbf{n}}_s$$

Example: Strike-slip faulting

$$\mathbf{S}_G = \begin{bmatrix} 30 & -8.66 & 0 \\ -8.66 & 40 & 0 \\ 0 & 0 & 30 \end{bmatrix}$$

$$strike = 60^\circ$$
$$dip = 90^\circ$$

$$\hat{\mathbf{n}} = \begin{bmatrix} -0.866 \\ 0.5 \\ 0 \end{bmatrix} \qquad \hat{\mathbf{n}}_s = \begin{bmatrix} 0.5 \\ 0.866 \\ 0 \end{bmatrix} \qquad \hat{\mathbf{n}}_d = \begin{bmatrix} 0 \\ 0 \\ 1.0 \end{bmatrix}$$

$$S_n = 40 \quad \tau_d = 0 \quad \tau_s = 8.66$$

Example: Normal faulting

$$\mathbf{S}_G = \begin{bmatrix} 4000 & 0 & 0 \\ 0 & 3000 & 0 \\ 0 & 0 & 5000 \end{bmatrix}$$

$$strike = 45^\circ$$
$$dip = 60^\circ$$

$$\hat{\mathbf{n}} = \begin{bmatrix} -0.612 \\ 0.612 \\ -0.5 \end{bmatrix} \qquad \hat{\mathbf{n}}_s = \begin{bmatrix} 0.707 \\ 0.707 \\ 0 \end{bmatrix} \qquad \hat{\mathbf{n}}_d = \begin{bmatrix} -0.3535 \\ 0.3535 \\ 0.866 \end{bmatrix}$$

$$S_n = 3875 \quad \tau_d = -650 \quad \tau_s = -433$$

Example: Normal faulting

$$\mathbf{S}_G = \begin{bmatrix} 5000 & 0 & 0 \\ 0 & 4000 & 0 \\ 0 & 0 & 3000 \end{bmatrix}$$

$$strike = 225^\circ$$
$$dip = 60^\circ$$

$$\hat{\mathbf{n}} = \begin{bmatrix} 0.612 \\ -0.612 \\ -0.5 \end{bmatrix} \qquad \hat{\mathbf{n}}_s = \begin{bmatrix} -0.707 \\ -0.707 \\ 0 \end{bmatrix} \qquad \hat{\mathbf{n}}_d = \begin{bmatrix} 0.3535 \\ -0.3535 \\ 0.866 \end{bmatrix}$$

$$S_n = 4125 \quad \tau_d = -650 \quad \tau_s = -433$$

Example: Revese faulting

$$\mathbf{S}_G = \begin{bmatrix} 2100 & -520 & 0 \\ -520 & 1500 & 0 \\ 0 & 0 & 1000 \end{bmatrix}$$

$$strike = 120^\circ$$
$$dip = 70^\circ$$

$$\hat{\mathbf{n}} = \begin{bmatrix} -0.814 \\ -0.470 \\ -0.342 \end{bmatrix} \qquad \hat{\mathbf{n}}_s = \begin{bmatrix} -0.5 \\ 0.866 \\ 0 \end{bmatrix} \qquad \hat{\mathbf{n}}_d = \begin{bmatrix} 0.2961 \\ -0.1710 \\ 0.9396 \end{bmatrix}$$

$$S_n = 1441 \quad \tau_d = 161 \quad \tau_s = 488$$