



$$T = R^T \nabla_n \psi + \psi b$$

$$n = (\cos\theta, \sin\theta), \quad b = (\sin\theta, -\cos\theta)$$

$$\hat{\psi}(\theta) = \psi(n)$$

$$\psi(\lambda n) = \psi(n)$$

$$\frac{\partial \psi}{\partial n_1} n_1 + \frac{\partial \psi}{\partial n_2} n_2 = 0$$

$$-\frac{\partial \psi}{\partial n_1} n_2 + \frac{\partial \psi}{\partial n_2} n_1 = \frac{\partial \hat{\psi}}{\partial \theta}$$

$$n_1 = \cos\theta, \quad \frac{dn_1}{d\theta} = -\sin\theta = -n_2$$

$$n_2 = \sin\theta, \quad \frac{dn_2}{d\theta} = \cos\theta = +n_1$$

rotation \rightarrow

$$\begin{pmatrix} n_1 & n_2 \\ -n_2 & n_1 \end{pmatrix} \nabla \psi = \begin{pmatrix} 0 \\ \frac{\partial \hat{\psi}}{\partial \theta} \end{pmatrix}$$

$$\nabla \psi = \begin{pmatrix} n_1 & -n_2 \\ n_2 & n_1 \end{pmatrix} \begin{pmatrix} 0 \\ \hat{\psi}_\theta \end{pmatrix}$$

$$R^T \nabla \psi = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} n_1 & -n_2 \\ n_2 & n_1 \end{pmatrix} \begin{pmatrix} 0 \\ \hat{\psi}_\theta \end{pmatrix}$$

$$= \begin{pmatrix} n_1 \\ n_2 \end{pmatrix} \frac{\partial \hat{\psi}}{\partial \theta}$$

$$= \hat{\psi}_\theta n$$

$K + L$ in

$$T = \hat{\psi}_\theta n + \psi b$$

capillary vector

Equilibrium Equation

$$\frac{d}{ds} T = \frac{d}{ds} (\hat{\psi}_\theta n + \psi b) \quad \text{on } \Gamma$$

$$\frac{d}{ds} T = \frac{d}{ds} (\psi_{\theta} u + \psi b)$$

$$\frac{db}{ds} = \kappa u$$

$$\frac{d\eta}{ds} = -\kappa b$$

$$= \psi_{\theta\theta} \frac{d\theta}{ds} u + \psi_{\theta} \frac{du}{ds} + \psi_{\theta} \frac{d\theta}{ds} b + \psi \frac{db}{ds}$$

$$= \psi_{\theta\theta} \kappa u + \psi_{\theta} (-\kappa b) + \cancel{\psi_{\theta} \kappa b} + \kappa u \psi$$

$$= (\psi_{\theta\theta} + \psi) \kappa u$$

Equilibrium:

$$(\psi_{\theta\theta} + \psi) \kappa = 0 \quad \text{on } \Gamma \quad \kappa = \text{curvature}$$

$$\sigma_n u = \mu \frac{dT}{ds}$$

line segment

Evolution

$$\sigma_n u = (\psi_{\theta\theta} + \psi) \kappa u \quad \text{on } \Gamma$$

(+)

parabolic