Total 2 pages

Total [100 points]

Mid-term Exam

Plasticity of Concrete Course

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Problem 1) $\boldsymbol{\phi}(\mathbf{X}) = X_1X_2^2\boldsymbol{e_1} - X_1^2X_2\boldsymbol{e_2} + X_3\boldsymbol{e_3}$ **[25 points]**

(a) Compute deformation gradient ***F***

(b) Compute Green deformation tensor ***C***

(c) Compute displacement ***u***

(d) Compute linearized strain tensor ***E***

Problem 2) Assume stress tensor **S** = $\begin{bmatrix} \frac{3}{2} & -\frac{1}{2} & 0 \\ -\frac{1}{2} & \frac{3}{2} & 0 \\ 0 & 0 & 3 \end{bmatrix}$ **[25 points]**

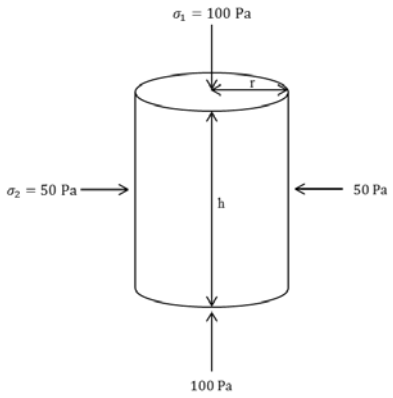
(a) Compute principal values and directions

(b) Compute Invariants of shear stress tensor ***S*** ($\boldsymbol{I_1}$, $\boldsymbol{I_2}$, $\boldsymbol{I_3}$)

(c) Compute deviatoric stress tensor

(d) Compute Invariants of deviatoric stress tensor ($\boldsymbol{J_1}$, $\boldsymbol{J_2}$, $\boldsymbol{J_3}$)

Problem 3) **[25 points]**



Axial pressure 100Pa
Confining pressure 50Pa
r = 1.0m
h = 2.0m
E = 10,000Pa
ν = 0.1

(a) Obtain stress tensor ***S***

(b) Compute strain tensor ***E***

(c) Compute volume change ΔV

Problem 4) Assume stress state $\mathbf{S} = \begin{bmatrix} 60 & 0 & 0 \\ 0 & 50 & 0 \\ 0 & 0 & -50 \end{bmatrix}$ kPa **[25 points]**

Yield stress σ_Y = 100 kPa

(a) Is this stress state admissible in von Mises?