

CE7640: Elastic and Plastic Stress Analysis

Project – 2: Plastic deformations

Tasks – 1:

- A. Formulate and solve the pure shear boundary value problem for the constitutive relation assigned to you below. Plot shear stress versus shear strain for (i) monotonically increasing shear strain from 0 to $4 \epsilon^y$ (ii) cyclically varying shear strain from 0 to $1.5\epsilon^y$ for 3 cycles, where ϵ^y is the yield strain in pure shear.
 - B. Formulate and solve the boundary value problem of fixed biaxial stretching of a plate for the constitutive relations assigned to you. Assume a plane state of stress with stretching along the x direction and no displacement along the y direction. Obtain the response of the plate when the strain along the x direction (i) is monotonically increased from 0 to $10\epsilon^y$, (ii) is cycled between 0 and $1.5 \epsilon^y$ three times, where ϵ^y is the yield strain in uniaxial extension.
1. **CE20D406 & CE21D016 & CE21D402:** von Mises yield criteria, non-Associated flow rule with Drucker – Prager flow condition, linear isotropic work hardening
 2. **CE21D042 & CE21D060:** von Mises yield criteria, Associated flow rule, linear isotropic strain hardening
 3. **CE21S007 & CE21S009:** von Mises yield criteria, Associated flow rule, no strain hardening
 4. **ME21S030 & ME21S032:** von Mises yield criteria, Associated flow rule, linear isotropic work hardening

Tasks – 2:

Formulate and solve the boundary value problem of a beam with square cross section of side one-tenth of the span subjected to uniformly distributed load of magnitude w , with boundary conditions as assigned to you below for elastic perfectly plastic constitutive relation with yield criteria given by von Mises and using associated flow rule. Assume w is increased monotonically from 0 to $3w_y$ where w_y corresponds to the load when the beam begins to deform plastically. Report the variation of the maximum displacement with w , reaction forces with w , deflected profile of the beam when $w = \{ w_y, 2w_y, 3w_y \}$.

1. **CE20D406 & CE21D016 & CE21D402:** Fixed at both ends
2. **CE21D042 & CE21D060:** Fixed at one end and guided roller at the other
3. **CE21S007 & CE21S009:** Propped cantilever – fixed at one end and roller at the other
4. **ME21S030 & ME21S032:** Simply supported – hinge at one end and roller at the other

Assume reasonable values for the material parameters in the constitutive relation. If any details about the constitutive relations is required contact the instructor.