

CVEN 7511 - Fall 2001
Computational Mechanics of Solids and Structures
Take-Home Midterm Examination
October 30, 2001

Elastic Large Deformation Analysis:

1. Problem:

Develop the total Lagrange formulation TLF of the internal force vector and the tangential stiffness matrix of a bilinear 2D plane strain element with four nodes. Assume uniform stretching of the element from its quadratic shape of unit size in the initial unstressed reference to the deformed rectangular state in which the element is stretched uniaxially by 50% using a linear elastic Kirchhoff material with $\lambda_o = \mu_o = 70 \text{ GPa}$ in terms of PK stress and Green strain. Compute the eigenvalues of the material and geometric stiffness matrices to validate positive definiteness.

2. Problem:

Apply the TLF above to analyze a direct shear test in which the bilinear square element is subjected to the angular distortion of $\alpha = 45^\circ$. Compute the different stress and strain measures of the elastic Kirchhoff material in order to compare the internal force vector of the TLF with those of the Update Lagrange Formulations, ULF using Kirchhoff and Cauchy stresses.