MAE5009: Continuum Mechanics B

Assignment 02: Strain and Displacement

Due October 9, 2021

1. Derive the six second-order and three fourth-order compatibility equations based on the six strain-displacement equations.

2. The following displacement field is applied to a certain body

$u = k\left(2x + y^2\right),\ v = k\left(x^2 - 3y^2\right),\ w = 0$

where $k = 10^{-4}$,

(a) show the distorted configuration of a two-dimensional element with sides dx and dy and its lower left corner (point A) initially at the point (2,1,0), i.e., determine and sketch the new length and angular position of each side. You may exaggerate the plot to facilitate visualization;

(b) determine the coordinates of point A after the displacement field is applied;

(c) find ω_z at this point;

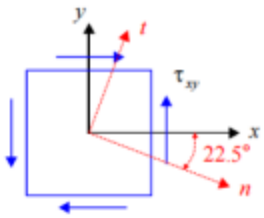
(d) find the maximum, minimum normal strain and maximum shear strain at this point.

3. Given the following system of strains,

$$\varepsilon_x = 5 + x^2 + y^2 + x^4 + y^4$$
$$\varepsilon_y = 6 + 3x^2 + 3y^2 + x^4 + y^4$$
$$\gamma_{xy} = 10 + 4xy\left(x^2 + y^2 + 2\right)$$
$$\varepsilon_z = \gamma_{xz} = \gamma_{yz} = 0$$

determine if the system of strains is possible.

4. For the strain $\varepsilon_x = \varepsilon_y = 0$, $\gamma_{xy} = 0.002828$ (in *x*-*y* coordinate system) at a specific point in an isotropic material, using the Mohr's circle of strain to determine the strain components ε_n, ε_t, and γ_{nt} in *n*-*t* coordinate system shown in the following figure.



5. A thin rectangular plate with dimensions 3 cm × 4 cm is acted upon by a stress distribution which results in the uniform strains

$$\varepsilon_x = 0.0025,\ \varepsilon_y = 0.0050,\ \varepsilon_z = 0,\ \gamma_{xy} = 0.001875,\ \gamma_{xz} = \gamma_{yz} = 0$$

as shown in the following figure. Determine the change in length of diagonal AB.