Advanced rock mechanics

Semester 1, 2009

Homework #4 (23 March)

due by 29 March 2009

1. A displacement field is given by $u_1 = 3x_1x_2^2$, $u_2 = 2x_3x_1$, $u_3 = x_3^2 - x_1x_2$. Determine the strain tensor ϵ_{ij} and check whether or not the compatibility conditions are satisfied.

2. Given the following stress distribution,

$$\tau_{xx} = 3x^2 + 4xy - 8y^2$$
$$\tau_{yy} = 2x^2 + xy + 3y^2$$
$$\tau_{xy} = -\frac{1}{2}x^2 - 6xy - 2y^2$$
$$\tau_{zz} = \tau_{zx} = \tau_{yz} = 0$$

determine, in the absence of body forces, whether equilibrium exists.

3. Discuss (and summarize) the physical interpretation of the divergence of a vector (less than a page). You may take examples from stress equilibrium, flow of an incompressible fluid, heat conduction or fluid flow in porous media.