

**Problem M16**

The purpose of this question is to demonstrate the equivalence of the two methods at our disposal for transforming strain (and stress) and for calculating the principal values and directions.

Given a state of plane strain:  $\epsilon_{11} = -0.000200$ ,  $\epsilon_{22} = +0.000400$ ,  $\epsilon_{12} = -0.000200$ , do the following:

- a) Draw a Mohr's circle for the strain state. Note you may find it convenient to work in terms of "micro-strain" (strain/ $10^{-6}$ )
- b) From the Mohr's circle determine the principal strains  $\epsilon_1$  and  $\epsilon_2$  and principal directions,  $\tilde{x}_1$  and  $\tilde{x}_2$ . You should specify the directions as counterclockwise angles with respect to the original  $x_1$  and  $x_2$  coordinate system.
- c) Determine the direction cosines for the transformation between  $x_1, x_2$  and  $\tilde{x}_1, \tilde{x}_2$
- d) Using the appropriate tensor operation show that the original strain tensor ( $\epsilon_{mn}$ ) transforms to the principal strain tensor ( $\tilde{\epsilon}_{pq}$ ).