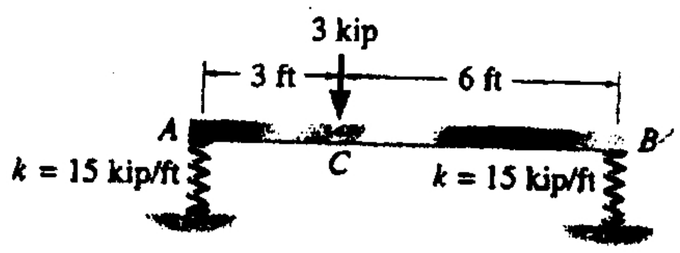
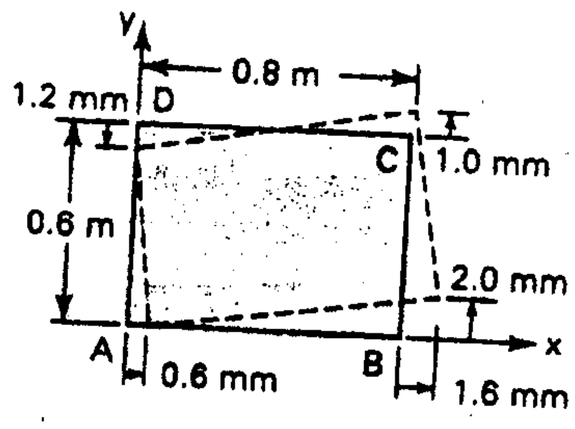
1. (1) Define plane stress (x-y plane) problem and plane strain (x-y plane) problem. **(10%)**
   (2) Derive the elastic constitutive relations for plane stress (x-y plane) problem and plane strain (x-y plane) problem. **(20%)**

2. The steel bar is supported by two springs at its ends A and B. Each spring has a stiffness of k = 15 kip/ft and is originally unstretched. The bar is loaded with a force of 3 kip at point C. Neglect the weight of the bar and take $E_{st} = 29\times10^3$ ksi, I = 12 in^4. (1) Determine the vertical displacement of point C induced by rigid body motion. **(10%)** (2) Determine the total vertical displacement of point C. **(10%)**



3. A 0.8-m by 0.6-m rectangle ABCD is drawn on a thin plate prior to loading. Subsequent to loading, the deformed geometry is shown by the dash lines. The material's modulus of elasticity $E = 210$ GPa, and Poisson's ratio $\nu = 0.3$. (1) Determine the components of plane strain at point A. **(10%)** (2) Determine the in-plane principal strains at point A and the directions in which they act. **(10%)** (3) Determine the principal stresses at point A. **(10%)**



4. The boom of a crane is constructed of steel, $E = 210$ GPa; the yield point stress is 210 MPa. The cross section is rectangular with a depth of 100 mm and a thickness of 50 mm. Determine the buckling load of the column W_{cr}. **(20%)**