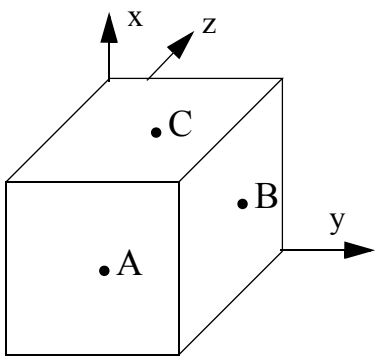
EXAM 1 MEEM2150 Feb. 17th, 2010

1.

(i) Show the non-zero stress components on the A,B, and C faces of the cube. Use only the coordinate system that is given.

$$\begin{bmatrix} \sigma_{xx} = 20\text{ksi(C)} & \tau_{xy} = -10\text{ksi} & \tau_{xz} = 0 \\ \tau_{yx} = -10\text{ksi} & \sigma_{yy} = 0 & \tau_{yz} = 15\text{ksi} \\ \tau_{zx} = 0 & \tau_{zy} = 15\text{ksi} & \sigma_{zz} = 25\text{ksi(T)} \end{bmatrix}$$



In problems (ii) through (x) **circle** the correct answer.

(ii) Stress components are opposite in direction on the two surfaces of an imaginary cut. True / False

(iii) Stress components have opposite signs on the two surfaces of an imaginary cut. True / False

(iv) A stress element can be drawn to any scale. True / False

(v) If the left end of a rod moves more than the right end in the negative x direction, then the normal strain in the x direction will be negative. True / False

(vi) When angle decreases from right angle we obtain positive shear strain. True / False

(vii) In Lagrangian strain the original undeformed geometry is used as the reference geometry. True / False

(viii) In isotropic materials the stress and strain relationship is same in all directions. True / False

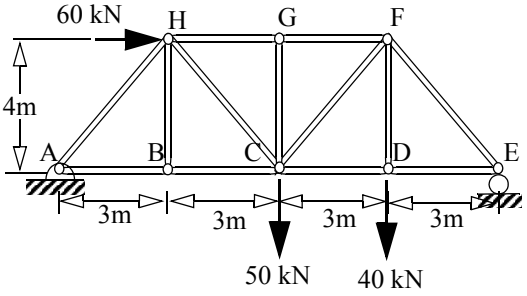
(ix) Ductile materials show large elastic deformation but small plastic deformation before fracture. True / False

(x) The most general anisotropic material has 21material constants that relate stress and strain linearly. True / False

(xi) The normal stresses at a point were found to be $\sigma_{xx} = 200$ MPa (T), $\sigma_{yy} = 120$ MPa (T). The material has a modulus of elasticity of E = 200 GPa and Poisson's ratio $\nu = 0.25$. Determine the normal strain in the x-direction (ε_{xx}) assuming *Plane Strain*.

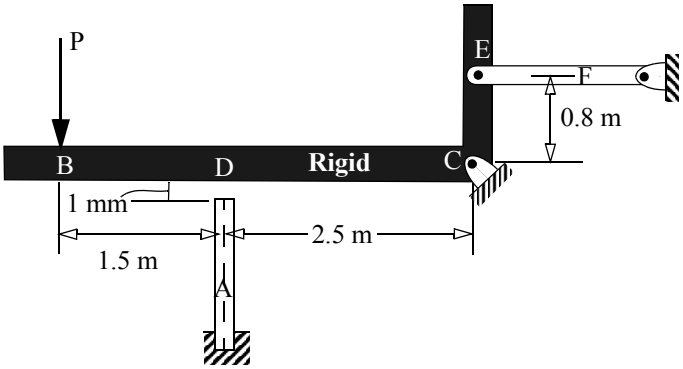
(xii) The axial strain in a rod is given by $\varepsilon_{xx} = \dfrac{K}{(x - 2L)^2}$, where K is a constant for a given material and L is the length of the rod. Determine the elongation of the rod in terms of K and L.

2. The circular members of a pin connected truss shown have a diameter d =20 mm, modulus of elasticity E= 70 GPa, and Poisson's ratio $\nu = 0.25$. Determine (a) the axial stresses in members HC and FE; (b) the change in diameter of member FE.



3. BCDE is a rigid member. A gap of 1 mm exists before application of force P between member A and BCDE. Point B was observed to move downward by 2.0 mm due to the application of force P. Bars A and F are1.2 m and 1.4 m long,

respectively. The bars have a modulus of elasticity of E = 200 GPa, yield stress of σ_{yield} = 200 MPa, ultimate stress σ_{ult} = 350 MPa and cross-sectional area of 400 mm ^{2}. Determine (a) the applied force P; and (b) the factor of safety for the system if yielding is to be avoided in both bars.



ANSWERS

1 (ii) T (iii)F (iv)T (v)F (vi)T (vii)T (viii)T (ix)F (x)T

(xi) ε_{xx} = 750 μ (xii) Elongation = K/(2L)

2. σ_{HC} = 59.68 MPa(T); σ_{FE} = 298.4 MPa(C) ; Δd_{FE} = 0.0213 m.

3. P= 14.99 kN; K_{safety} = 3.5