編號： 175 系所：工程科學系在職專班乙組　科目：材料力學（專班）

本試題是否可以使用計算機： ☑可使用 ， □不可使用 （請命題老師勾選）

每題各佔25分，共4題合計100分.

1. A PCB board is clamped by a vibration isolation unit which consists of two blocks of hard rubber bonded to rigid supports as shown in Fig.1. The rubber has a modulus of rigidity 1.75 ksi and maximum shear stress 200 psi. Also the maximum allowable displacement of PCB is 3/16 in. Knowing that c=4 in and P = 10 kips,

(a) Consider the rubber is a linear elastic material, then determine the smallest allowable dimensions a and b of the rubber blocks.

(b) Using the dimensions of rubber blocks determined in (a), compute the effective spring constant (i.e. Force/PCB displacement) of the vibration isolation unit.

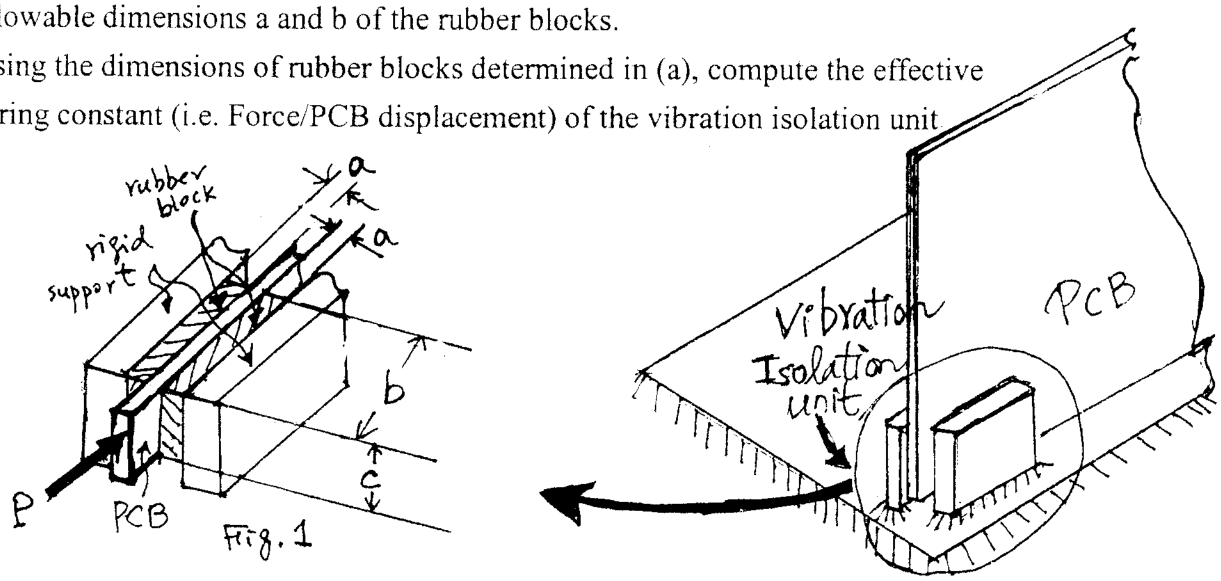


Fig. 1

2. A dog bone specimen as shown in Fig.2 is under a tensile test. The material has a Young's modulus 70 GPa and an allowable tensile stress 200 MPa. Determine the maximum allowable value of tensile load and the corresponding total elongation of the specimen. Consider the specimen is a linear elastic material.

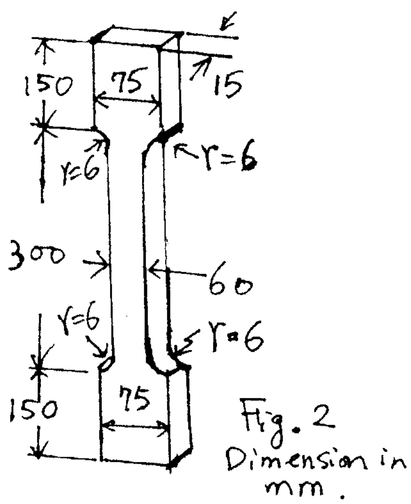
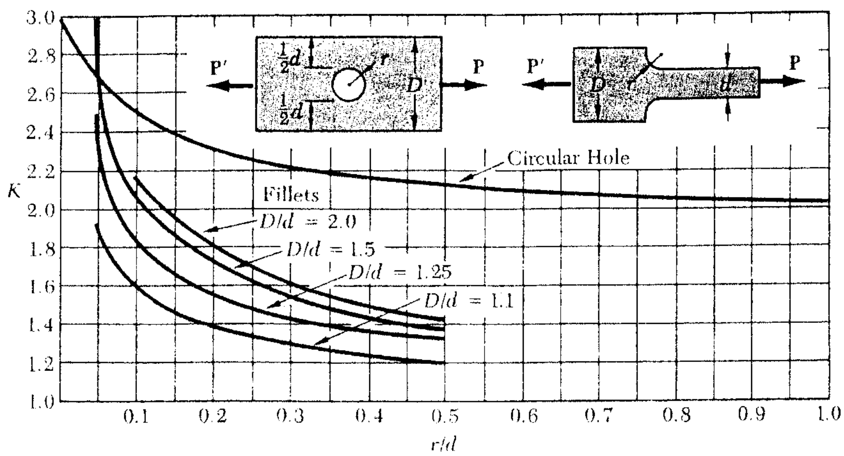


Fig. 2
Dimension in mm.



Stress concentration factors for *flat bars* under axial loading.† Note that the average stress must be computed across the narrowest section: $\sigma_{ave} = P/td$, where t is the thickness of the plate.

3. Five layer of metal strips, each 40 mm wide, are bonded together to form the composite beam as shown in Fig.3. Knowing that the beam is bent elastically about a horizontal axis by a couples of moment M=1800N.m, determine the maximum stress (a) in the core metal (b) in the median-layer metal, (c) in the outer-layer metal. (d) Also, determine the radius of curvature of the composite beam. The modulus of elasticity is 210 GPa for the core metal, 105GPa for the median-layer metal, and 70GPa for the outer-layer metal.

Notice: You must use the outer-layer metal as reference to compute the moment of inertia of the transformed section in this problem.

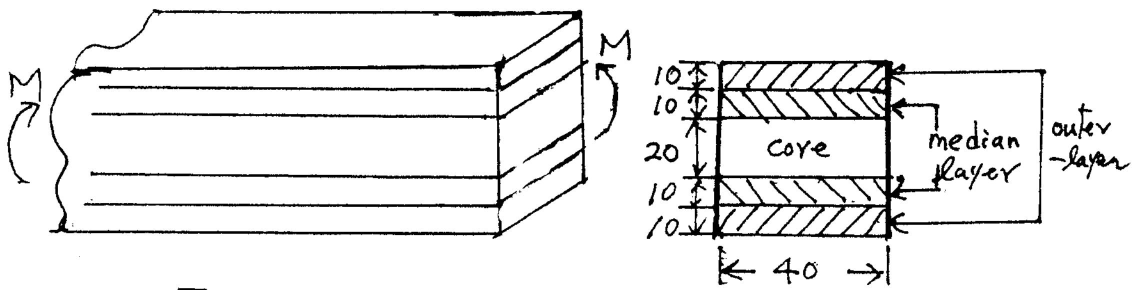


Fig. 3. Dimension in mm.

4. A thin-walled pressure vessel with elastic and isotropic behavior is under internal pressure. A strain gage is attached horizontally to the cylindrical surface of the pressure vessel of 600mm outside diameter and 7.50mm wall thickness. Knowing that E=200GPa and ν=0.25 and that the strain gage reads 120μ, determine (a) the three principal strains on the cylindrical surface of the vessel, (b) the principal stresses in the wall, (c) the gage pressure inside the vessel.

Hint: Three dimensional isotropic Hooke's law, e.g.

$$\varepsilon_x = \frac{\sigma_x}{E} - \nu\frac{\sigma_y}{E} - \nu\frac{\sigma_z}{E}$$

etc.

The longitudinal stress and the hoop stress of a thin-walled pressure vessel are

$\frac{pr}{2t}$ and $\frac{pr}{t}$ respectively.

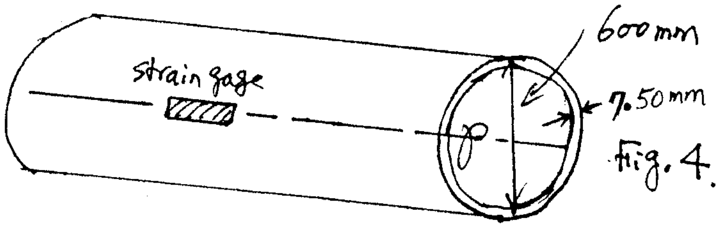


Fig. 4.