※ 考生請注意：本試題 ☑可 ☐不可 使用計算機，每題25分，共四題總計100分！

1.A 30cm(ie.12in) Si-wafer is clamped by a grip system which consists of two blocks of hard rubber bonded to the conveyer as shown in Fig.1. The rubber has a modulus of rigidity 12MPa and maximum shear stress 1.4MPa. Also the maximum allowable displacement of wafer is 5.0 mm. Knowing that b=16cm and P=44.5kN,

(a) Determine the smallest allowable dimensions a and c of the rubber blocks , if the rubber is linearly elastic material.

(b) In order to study the vibration prevention , the effective spring constant of the grip system (ie. Force/rubber displacement) must be computed. Based on (a),compute the spring constant.

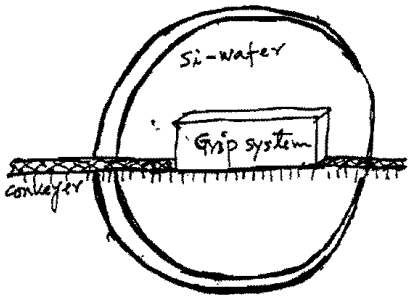
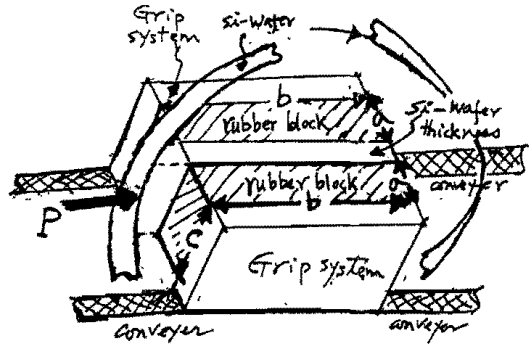


Fig. 1.



2.The stepped –circular shaft is designed elastically to transmit a power of 150KW to a manufacturing machine. The geometry of shaft is shown in Fig2. with special requirement in the radius of the fillet r=6mm. Based on the design code, the smallest permissible frequency of rotation is 450rpm (revolution/min) and the maximum allowable shear stress of the material is 50MPa, does the shaft design satisfy the code requirements?

Formulas: Power = 2π freq × (Torque)

$\tau_{max} = T\rho/J$; $J=(1/2)\pi\rho^4$

1W(watt) = 1 Nm/Sec.

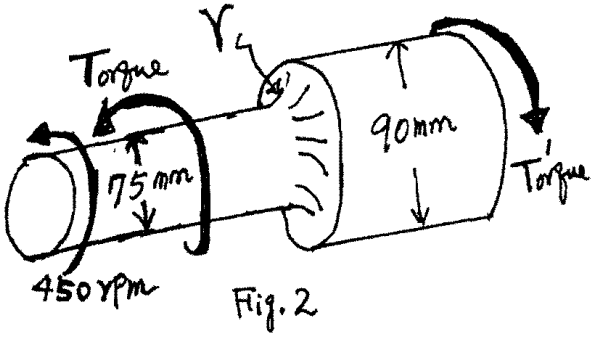
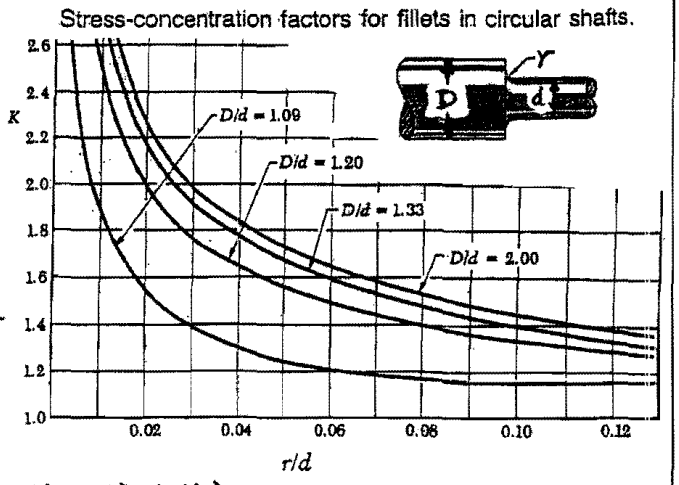


Fig. 2



（背面仍有題目，請繼續作答）

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3.The cylindrical steel tank has a 500mm inside diameter and 10mm thickness The steel has Young's modulus 200GPa and Poisson's ratio 0.30.The tank contains a pressurized gas. The gas pressure P can be indicated by the pressure gauge, the reading is 2.0MPa. A field engineer uses a single strain gage forming an angle 30° with a horizontal plane to check the accuracy of pressure gauge. The strain gage reading is 350 μ .Is the reading of pressure gauge accurate? The steel is elastic and isotropic.

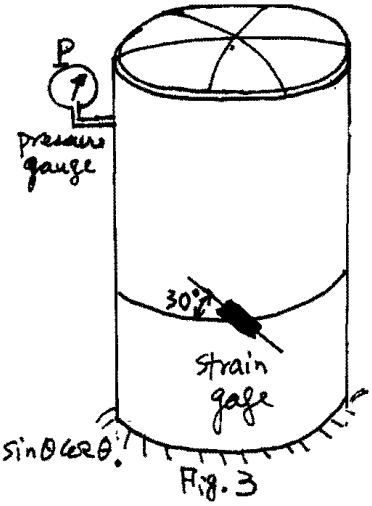


Fig.3

Formulas:

Hoop stress = Pr/t ,Axial stress = Pr/2t

Isotropic Hooke's Low:

$$\varepsilon_x = \sigma_x/E - \nu\sigma_y/E - \nu\sigma_z/E$$

$$\varepsilon_y = \sigma_y/E - \nu\sigma_x/E - \nu\sigma_z/E$$

$$\varepsilon_z = \sigma_z/E - \nu\sigma_x/E - \nu\sigma_y/E$$

$$\gamma_{xy} = \tau_{xy}/G,\ \gamma_{yz} = \tau_{yz}/G,\ \gamma_{zx} = \tau_{zx}/G$$

$$G = E/2(1+\nu)$$

Strain gage formula:

$$\varepsilon(\theta^\circ) = \varepsilon_x \cos^2\theta + \varepsilon_y \sin^2\theta + \gamma_{xy} \sin\theta\cos\theta$$

4.(a) A thin strip as shown in Fig.4a, is bent by a couple M_1, Determine the locations and the magnitude of maximum stress σ_1 and the curvature ρ_1 of the strip.

(b) Two thin strips in problem 4(a) are bent first by M_1 separately and then are glued together as shown in Fig.4b. After the two surfaces in contact have been securely bonded, the couples are removed as shown in Fig.4C. Determine the final stresses at points A,B,C,D and the final radius of curvature, if the material behavior is linearly elastic and $t << \rho_1$. Formulas: $I_x = (1/12)ab^3$, $I_y = (1/12)a^3b$, $\sigma = -My/I_x$, $\rho M = EI$

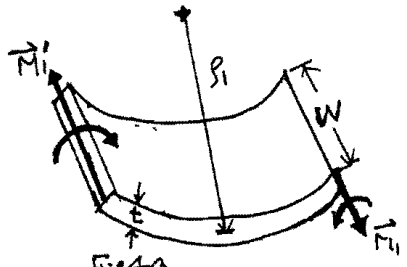
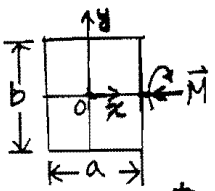


Fig.4a



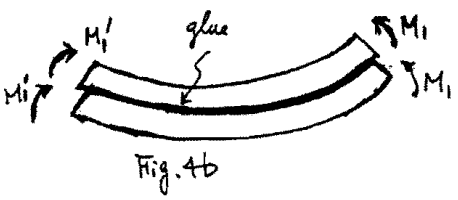


Fig.4b

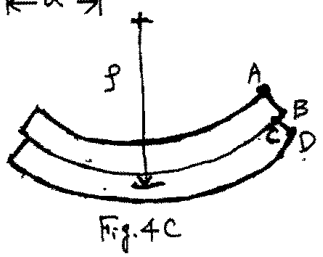


Fig.4C