

科目：451 工程力學

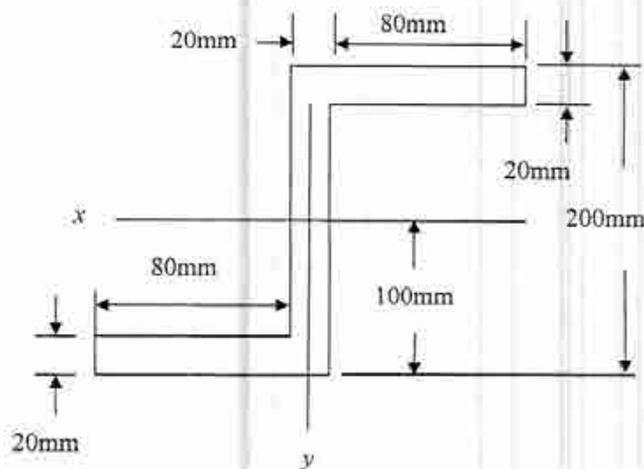
系組：土木系

(本試題共 2 頁，第 / 頁)

考生注意：1. 依次序作答，只要標明題號，不必抄題。  
2. 答案必須寫在答案卷上，否則不予計分。  
3. 試題隨卷繳回。

- (1) A steel Z-bar is used as a cantilever beam having a length of  $2.0\text{ m}$ . When viewed from the free end toward the fixed end of the beam, the cross section has the orientation and dimensions shown in Figure 1. A concentrated load  $P = 14.0\text{ kN}$  acts at the free end of the beam at an angle  $\phi = 1.25\text{ rad}$ .
- (a) Determine the maximum flexure stress in the beam.
- (b) Determine the deflection of the beam ( $E = 200\text{ GPa}$ ). (30%)

Figure 1



- (2) The state of stress at a point is given by  $\sigma_{xx} = -120\text{ MPa}$ ,  $\sigma_{yy} = 140\text{ MPa}$ ,  $\sigma_{zz} = 66\text{ MPa}$ ,  $\sigma_{xy} = 45\text{ MPa}$ ,  $\sigma_{yz} = -65\text{ MPa}$ , and  $\sigma_{zx} = 25\text{ MPa}$ .

Determine the three principal stresses and directions associated with the three principal stresses. (25%)

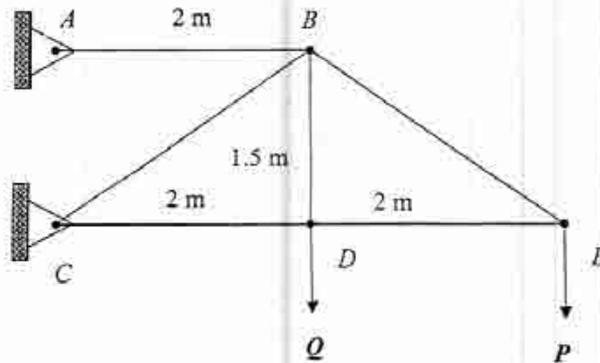
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- (3) The pin-connected truss in Figure 3 is made of an aluminum alloy for which  $E = 72.0 \text{ GPa}$ . The magnitudes of the loads are  $P = 10 \text{ kN}$  and  $Q = 5 \text{ kN}$ . Members  $BC$ ,  $CD$ , and  $DE$  each have cross-sectional area of  $900 \text{ mm}^2$ . The remaining members each have cross-sectional area of  $150 \text{ mm}^2$ . Use the energy method to determine the rotation of member  $BE$  caused by the loads  $P$  and  $Q$ . (25%)

Figure 3



- (4) (a) Describe the definition of shear center. (10%)  
(b) For a material subjected to multiaxial states of stress, give one example of failure criteria. (10%)