1. A steel pipe and an aluminum pipe are securely bonded to form the composite beam as shown in Fig. 1. The Young's modulus is E_s for the steel and E_a for the aluminum. Further, the shear modulus G_s for the steel and G_a for the aluminum.

   Questions: (a) For a tensile force F, what the stress is in each material. (5%)

   (b) For a torque T, what the maximum shearing stress in each material. (10%)

   (c) For a bending moment M, what the maximum stress is each material. (10%)

2. A square box beams made of two $20\times80-mm$ planks and two $20\times120-mm$ planks nailed together is shown in Fig. 2. Knowing that the space between nails is $s=50\ mm$ and that the allowable shearing force in each nail is 300 N, determine (a) the largest allowable vertical shear each type of beam, (b) the corresponding maximum shearing stress in each type of beam. (13%, 12%)

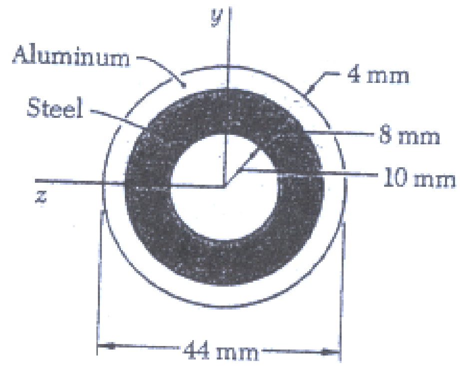

Fig. 1

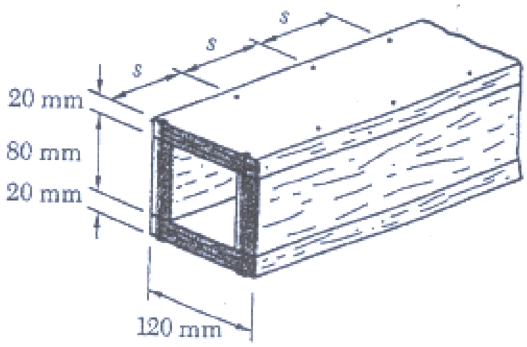

Fig. 2

(背面仍有題目,請繼續作答)

3. A Bernoulli-Euler beam subjected to a block of mass m at the mid-span is shown in Fig. 3. The beam has Young's modulus E, length L and moment of inertia I. The axial displacement u is expressed as $u = -y\frac{dw}{dx}$, where w is the transverse deflection.

Questions: (a) Express the strain ε, stress σ and bending moment M in terms of w. (5%)

(b) Express the strain energy per unit length in terms of bending moment. (5%)

(c) Express the distribution of bending moment in terms of m. (5%)

(d) Using the energy method to find the transverse deflection at the loading point. (10%)

4. Fig. 4 shows that a block of mass m is dropped from a height h onto the same beam at the mid-span as described in problem 3. (25%)

Question: Find the maximum transverse deflection at the loading point.

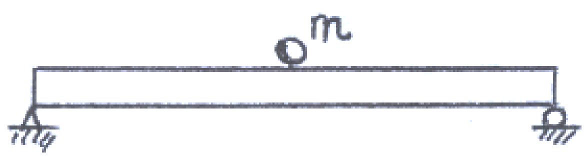

Fig. 3

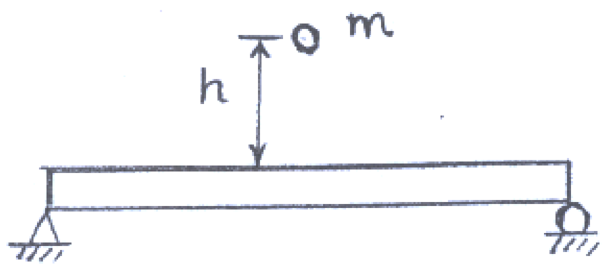

Fig.4