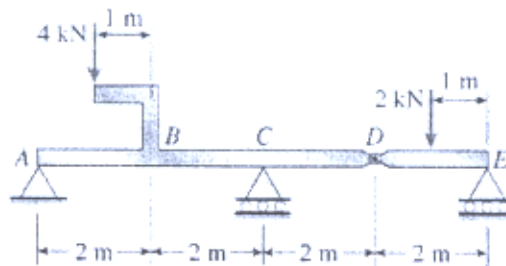1. (25%) For linearly elastic isotropic materials, there is a relation between the Young's modulus E, the shear modulus G, and the Poisson's ratio ν, i.e., they are related by the following equation:

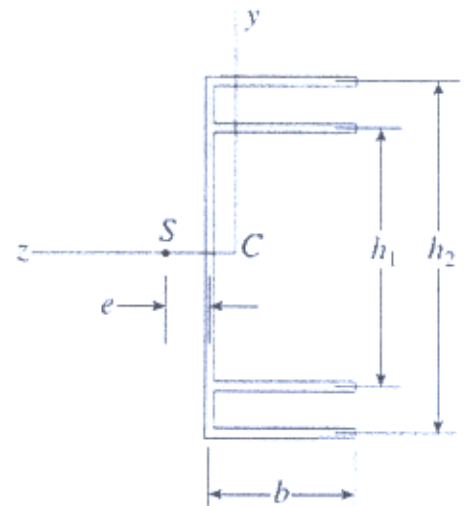$$G = \frac{E}{2(1+\nu)}$$

Derive this equation.

2. (25%) Draw the shear force and bending-moment diagrams for the compound beam.

3. (25%) The cross section of a channel beam with double flanges and constant thickness throughout the section is shown in the figure. Derive the following formula for the distance e from the centerline of the web to the shear center S:

$$e = \frac{3b^2(h_1^2 + h_2^2)}{h_2^3 + 6b(h_1^2 + h_2^2)}$$

4. (25%) The figure shows a nonprismatic, propped cantilever beam AB with flexural rigidity $2EI$ from A to C and EI from C to B. Determine all reactions of the beam due to the uniform load of intensity q.

E E10 4-2