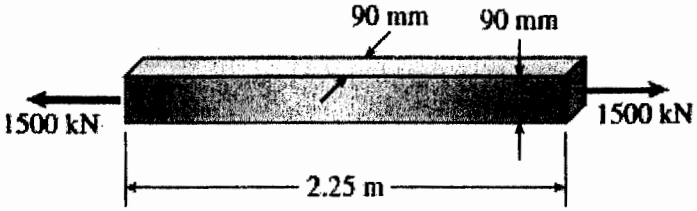
※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

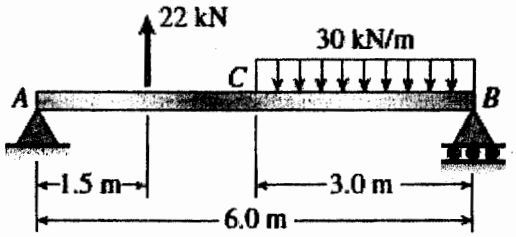
2014 Biomedical Engineering Master Entrance Exam — Mechanics of Materials (不可用計算機)

計算題：每題 20 分

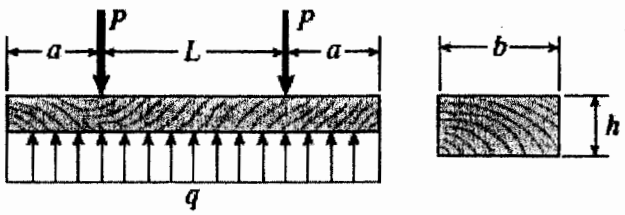
1. A brass bar of length 2.25 m with a square cross section of 90 mm on each side is subjected to an axial tensile force of 1500 kN (see figure). Assume that E = 110 GPa and Poisson's ratio: ν= 0.34. Determine the increase in volume (and ratio) of the bar.



2. The simple beam AB shown in the figure supports a concentrated load and a segment of uniform load. Draw the shear-force and bending-moment diagrams for this beam.



3. A railroad tie (or *sleeper*) is subjected to two rail loads, each of magnitude P = 175 kN, acting as shown in the figure. The reaction of the ballast is assumed to be uniformly distributed over the length of the tie, which has cross-sectional dimensions b = 300 mm and h = 250 mm. Calculate the maximum bending stress σ_{max} in the tie due to the loads P, assuming the distance L = 1500 mm and the overhang length a = 500 mm.



(背面仍有題目，請繼續作答)

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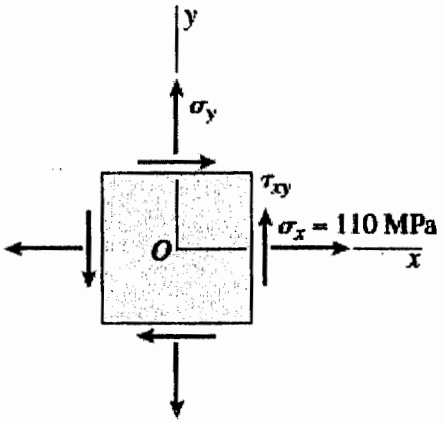
4. The surface of an airplane wing is subjected to *plane stress* with normal stresses σ_x and σ_y and shear stress τ_{xy}, as shown in the figure. At a counterclockwise angle $\theta = 32°$ from the x axis, the normal stress is 37 MPa tension, and at an angle $\theta = 48°$, it is 12 MPa compression. If the stress σ_x equals 110 MPa tension, what are the stresses σ_y and τ_{xy}?

Hint: $$\sigma_{x1} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos(2\theta) + \tau_{xy}\sin(2\theta)$$



5. A uniformly loaded steel wide-flange beam with simple supports has a downward deflection of 10 mm at the midpoint and angles of rotation equal to 0.01 radians at the ends. Calculate the height h of the beam if the maximum bending stress is 90 MPa and the modulus of elasticity is 200 GPa.

Hint: $$\delta = \delta_{max} = \frac{5qL^4}{384EI} \quad \theta = \theta_A = \frac{qL^3}{24EI}$$