

(一) Part of a garden roof is designed to have a glass dome so that glass could bring natural light inside. The structural frames for the roof are made of steel and one of the simplified plane frame models is shown in Fig. 1. Assuming the members are designed as beam elements and connections at B, C, D, and E are pin connected, calculate the following items:

- a) Reactions at F (Fixed end). 10%
- b) Internal forces on joint C so that pin rod can be designed. 15%

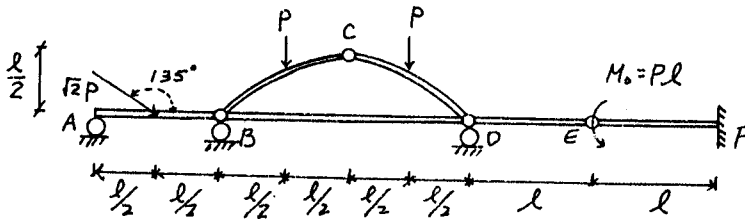


Fig. 1.

(二) A member is fixed at top, as shown in Fig. 2., the lower end of the member is separated from a rigid surface by a distance Δ . The rectangular cross section of the member is 20×5 mm, the Young's Modulus is 100 GPa, and the axial load applied at the middle of the length is equal to 15 kN. The material property is elasto-plastic which means that after yielding the material has no strength to resist any stress and will deform infinitely. The yielding stress is 100 MPa. Calculate the displacement of section a-a when

- a) $\Delta = 1.5$ mm, 10%
- b) $\Delta = 2.5$ mm. 20%
- c) If the buckling strength needs to be doubled in case b, what can be done to achieve this goal? Discuss your options. 10%

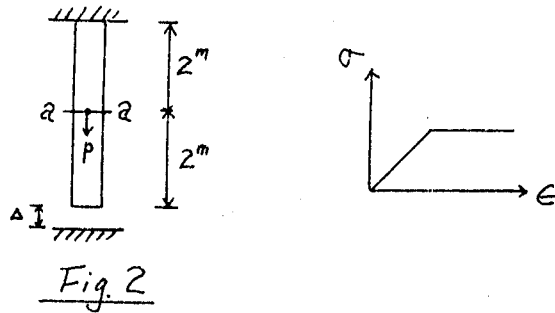


Fig. 2

(三) Explain the meaning of the following terms:

- a) Residual Stress 5%
- b) Stress Concentration Effect 5%
- c) Principal Stress 5%

(四) Solve the following equations.

- a) $y'' + 2y' + 10y = 25x^2 - 3e^{-x}$ 10%
- b) $y'' + 2y' + y = \cos^2 x$ 10%