UNIVERSITY OF LONDON

B.Sc. (ENGINEERING) EXAMINATION 1964

PART III

for Internal and External Students

(21) THEORY OF STRUCTURES

Friday 15 June: 10 to 1

Answer FIVE questions only.

1. A link having a relatively small uniform section and of the shape shown in Figure 1 is under the action of a pull P applied along its longitudinal axis. The portions ABC and FED are semicircles, AF and CD are straight and parallel to each other.
Draw the bending moment diagram and find the increase in the distance BE produced by the applied loads P. Consider strain energy due to bending only.

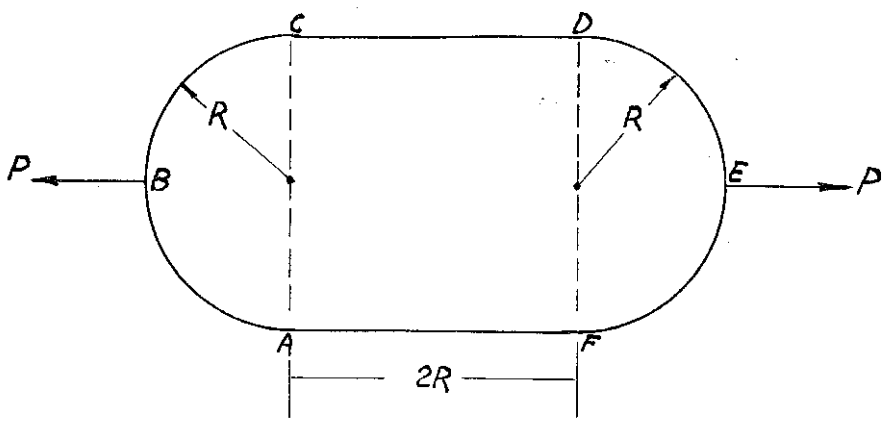

Figure 1

Turn over

RP 64/129/28/2/350
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2. A cantilever having a constant depth h but a varying width between A and B as shown below in Figure 2, is under the action of a vertical load P applied at point B. Find the vertical deflection of the end C.

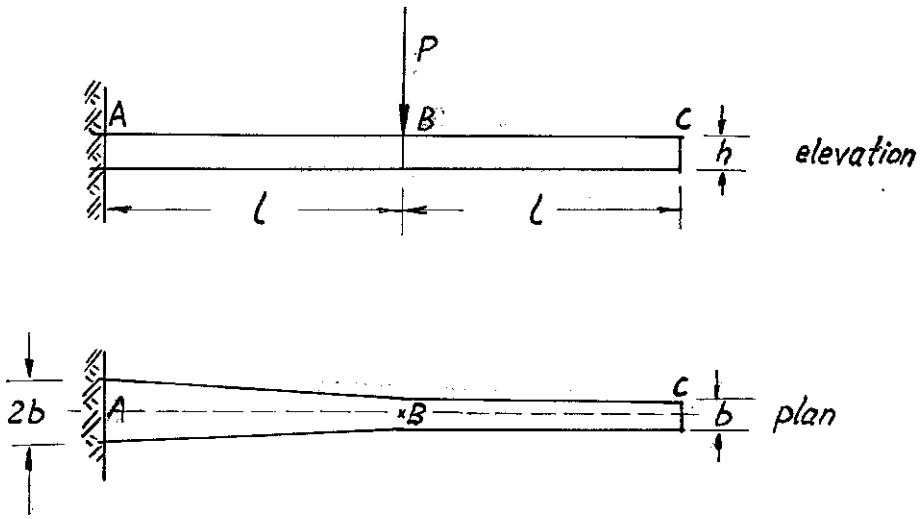


Figure 2

3. Draw the diagram of bending moments for the rigidly connected frame shown in Figure 3.

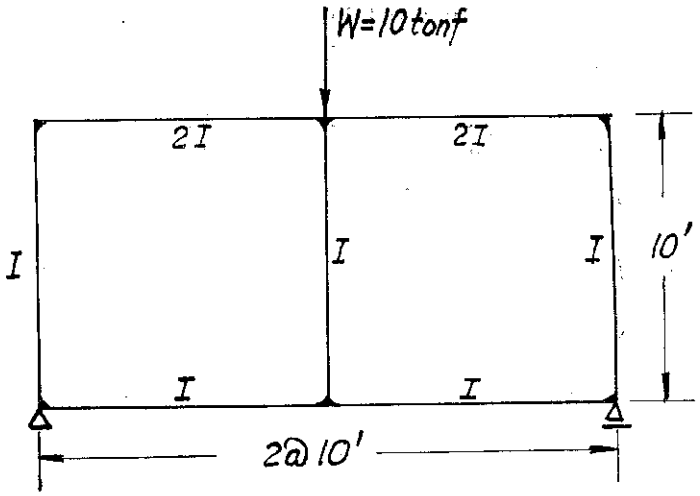
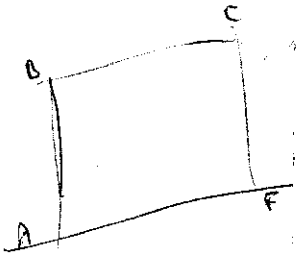
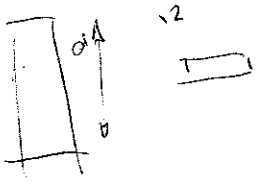


Figure 3



$\frac{M_A}{2}$

$I = \frac{3}{2}\frac{b}{12}h^3$



$\frac{b\,d^3}{12}$

4. A pin-connected space frame shown in Figure 4 consists of two regular tetrahedra *abcd* and *defg*, jointed together at the common hinge *d* and with three flexible cables *ag*, *be* and *cf*, all of equal length. The structure is pinned to the ground at the supports *e*, *f* and *g* and is under the action of a horizontal load *P*, applied at the joint *c* as shown.
All the members forming the tetrahedra are of the same length *a* and have the same cross-sectional area *A*.
Find the forces in all members of the frame.

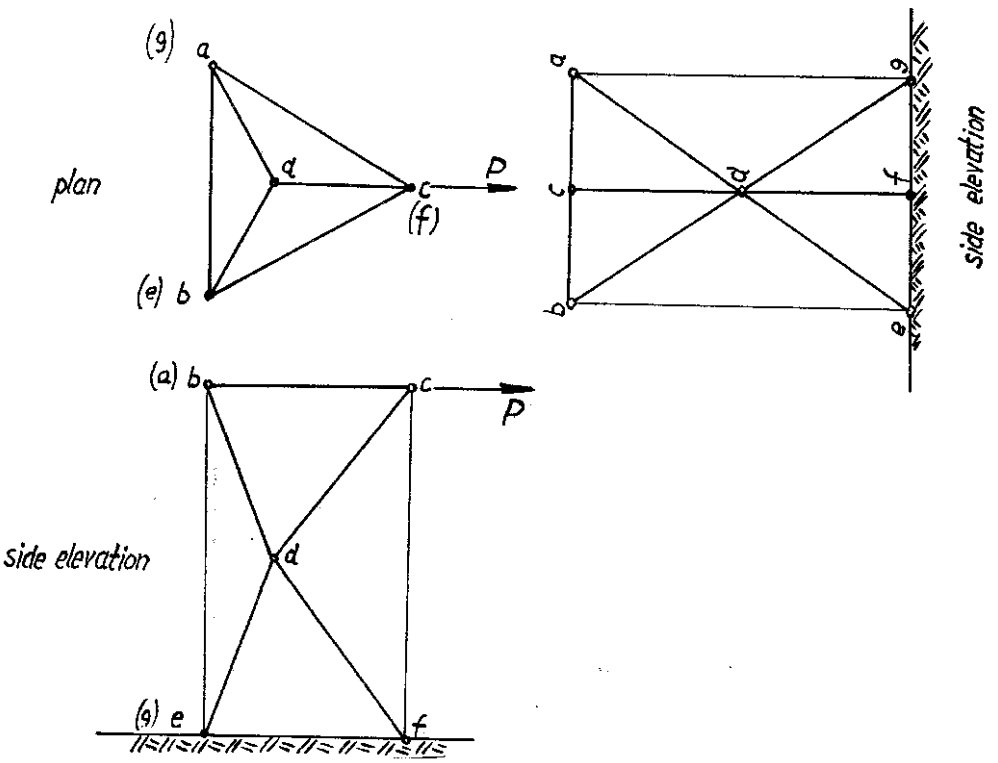


Figure 4

5. Find the shape factor for a built-up steel beam having the dimensions shown in Figure 5. The yield stress is 15·25 tonf/ in^2.

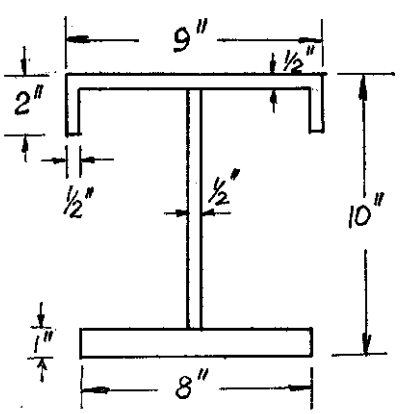


Figure 5

$S = \times Z = M$

$\frac{M}{I} = \frac{\sigma}{y}$ $\quad \times Z = \frac{M}{F}$

$Z = \frac{\Sigma}{A}$

6. Draw the influence lines for the vertical and horizontal reaction components at A, and axial forces in members 1–2, 1–3 and 2–3 of the braced three-pinned arch shown in Figure 6. All the members are pin-connected and the external load moves along a deck connected to the panel points between D and E.

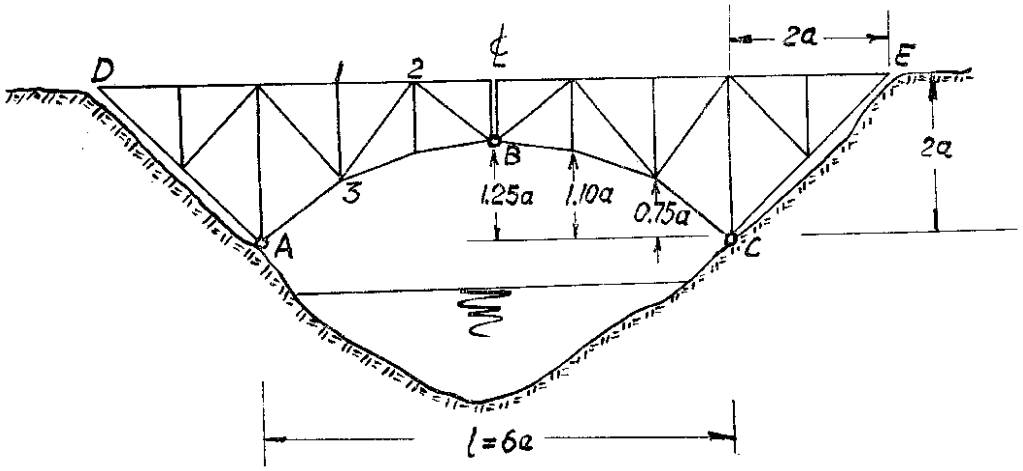


Figure 6

7. The members of the simply supported truss shown in Figure 7 are rigidly connected at all nodes. Find the expression for bending moment induced at the point of application of the vertical load $P = 1$ tonf. All the members have the same cross-sectional area A and the same constant EI.

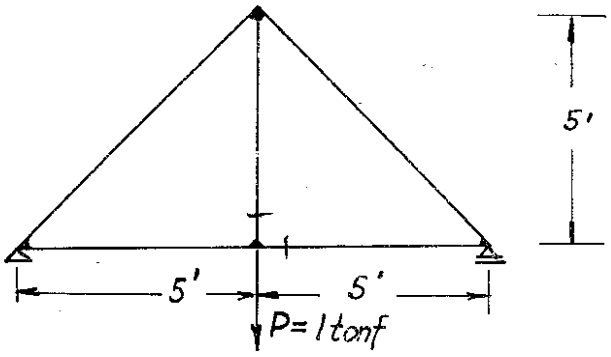


Figure 7

8. A steel tubular horizontal tie-bar carries an axial load of 1 tonf. The member is 2 ft long and is pinned at its ends. What uniformly distributed vertical load can be applied to the tie-bar to give a maximum tensile stress of 10 tonf/in^2? The O.D. of the bar is 2 in and the wall thickness is 1/32 in. Take E as 30×10^6 lbf/in^2.

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