

DESIGN OF STEEL STRUCTURES

Time : Three hours

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Maximum Marks : 100

Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.

All parts of a question (a, b, etc.) should be
answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answers may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

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Figures on the right-hand side margin indicate full marks.

Group A

1. Design a simply-supported gantry girder to carry one electric overhead travelling crane. Given data: 20

Crane capacity	= 300 kN
Weight of crane excluding trolley	= 190 kN
Weight of trolley	= 100 kN
Minimum approach of crane hook	= 1.2 m
Distance between centres of crane wheel	= 3.5 m
Distance between cranes of gantry girders	= 18 m
Span of gantry girder	= 6 m
Weight of rail section	= 0.30 kN/m
Height of rail section	= 75 mm

(Turn Over)

2. The span of knee roof trusses used, over an industrial building 8 m long, is 18 m, the spacing of roof trusses is 4 m. The pitch of roof truss is 1 in 4. The galvanized corrugated iron sheets are used for roof covering. The basic wind pressure is 1.5 kN/m^2 . The height of eaves above ground level is 8 m. Propose a suitable type of roof truss. Determine the loads at various panel points due to dead, live load and wind load. Also, determine the reactions. 20

3. An industrial shed, with roof 16 m span and rise 3.2 m with trusses spaced at 4 m apart, is provided as a railway siding in the medium wind zone of 47 m/s basic wind speed. Design the purling with channel and tube sections and compare them. 20

4. A steel tower is to be erected for transmission line for single circuit three-phase, 50 cycles/sec to transmit 50 MW at 0.75 power factor for 259 km. Given data:

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(i) Voltage of transmission = 132 kV

(ii) Power conductor = 30 mm ϕ ACSR

(iii) Unit weight of conductor = 16.76 N/m

(iv) Permissible axial tension = 35.60 kN

(v) Young's modulus of elasticity = $0.84 \times 10^5 \text{ N/mm}^2$

(vi) Coefficient of expansion = $0.00001992/^\circ\text{C}$

(vii) Shape factor for conductor = 0.67

(viii) Ground wire = 10 mm, ϕ permissible axial tension: 25.40 kN

(ix) Vertical height of conductor above ground = 6.7 m (minimum)

(x) Vertical spacing between power conductors = 3.5 m (minimum)

(xi) Horizontal spacing between power conductors = 6.25 m (minimum).

Height of ground wire above topmost conductor shall be half of the horizontal spacing of power conductors. Variation of temperature range 5°C to 60°C , uniform intensity of wind = 1.5 kN/m^2 .

Tangent types of towers with not more than 2° line deviation shall be erected, weight span of tower = wind span = 240 m. Suggest the geometry of the tower. 20

Group B

5. Design a through type plate girder bridge for single track B.G. mainline loading for the following data: 20

(i) Effective span = 24 m

(ii) Spacing of main girders = 5 m c/c

(iii) Spacing of cross-beams = 3 m c/c

(iv) Spacing of stringers: 2 m c/c

(v) Sleepers and their spacing = 250 mm \times 150 mm \times 2.8 m @ 0.4 m c/c

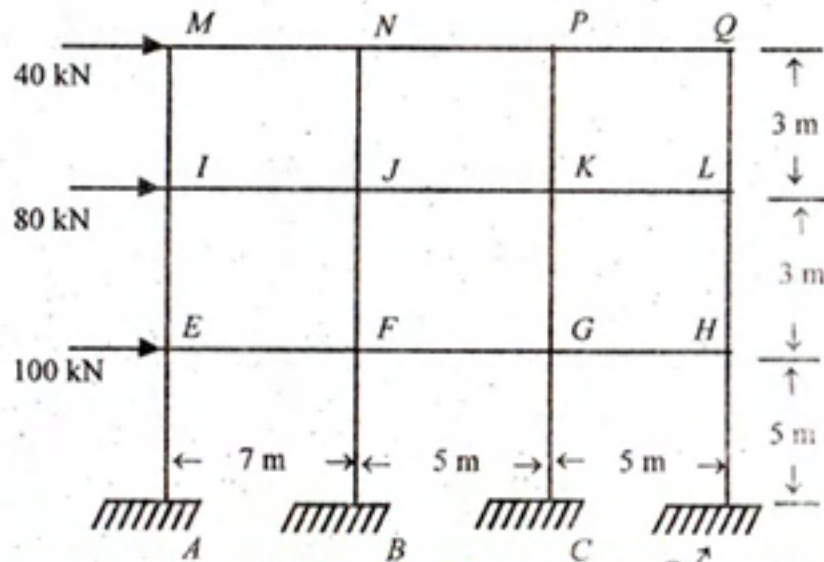
(vi) Density of timber = 7.4 kN/m^3

(vii) Weight of stock rails = 440 N/m

(viii) Weight of guard rails = 260 N/m

(ix) Weight of fastening, etc. = 280 N/m of track.

6. A self-supporting steel chimney is 60 m high and has a diameter 3 m at the top. Design the plate of the chimney. Also, design the base plate and anchor bolts. The foundation and riveted joints need not be designed. The horizontal pressure may be assumed as 1.50 kN/m^2 . The bearing stress in cement concrete is 4 N/mm^2 . 20.
7. Design an elevated cylindrical steel tank with hemispherical bottom for 1,60,000 litres capacity. The tank has conical roof. The ring beam of the tank is at a height of 10 m from the ground level. The tank is to be built at Delhi. Take $f_y = 250 \text{ N/mm}^2$. 20
8. A three-storeyed building frame has to carry equivalent live loads as shown in Fig 1. The inner columns have twice the area of cross-section as the outer columns. Find the bending moments on the bottom storey columns. Use cantilever method. 20



9. Answer the following in brief:
 - (i) What are the basic assumptions in analysis of industrial bents?
 - (ii) Mention the advantages of braced industrial building. Under what conditions unbraced buildings require bracing?
 - (iii) How do you calculate the self-weight of tower?
 - (iv) What are the lattice towers? Mention the loads acting on it.
 - (v) What is economical spacing of column in industrial buildings?
 - (vi) State the typical assumption of cantilever method.
 - (vii) What are the functions of bearing stiffeners and horizontal stiffeners in plate girders?
 - (viii) What are the minimum thickness of plates used and factor of safety against overturning in a steel chimney?
 - (ix) What is the ratio of stress between circumferential joint and radial joint in the conical bottom of steel tank.
 - (x) Draw a diagrammatic sketch of a through type pratt truss bridge with components.

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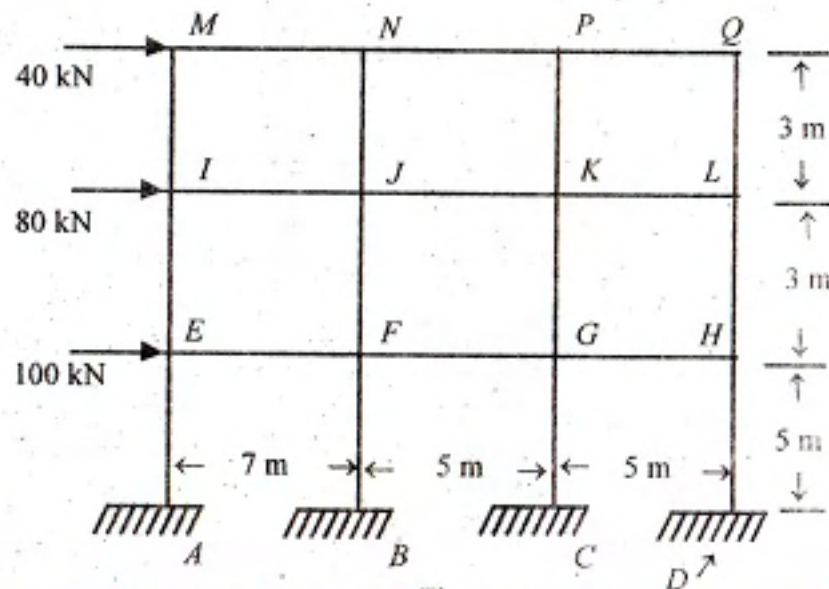


Fig. 1

9. Answer the following in brief: 10 × 2

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