

Sl. No. 18769

A-GUG-K-DFA

## CIVIL ENGINEERING

### Paper—I

( Conventional )

Time Allowed : Three Hours

Maximum Marks : 200

### INSTRUCTIONS

Candidates should attempt any FIVE questions.

The number of marks carried by each subdivision of a question is indicated at the end of the subdivision.

The total number of marks for each question will be 40.

Notations used are standard and will have their usual meanings, unless otherwise indicated.

Assume suitable data, if found necessary, and indicate them clearly. Newton may be converted to kgf using the relation 1 kilonewton (1 kN) = 100 kgf, if found necessary.

Answers must be written only in ENGLISH.

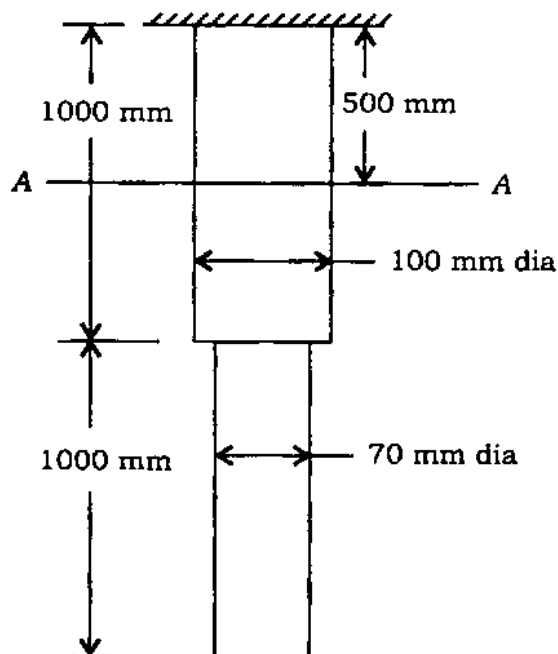
1. (a) Describe the procedure to list the soundness of cement. Name the constituents causing soundness. 10
- (b) What is ferrocement? List the properties of ferrocement. 10
- (c) Explain in detail the non-destructive testing of concrete using Rebound hammer. 10

(d) Write short notes on :

- (i) Electrical seasoning of wood 4
- (ii) Harmful ingredients in brick earth 3
- (iii) Tests on brick to assess its suitability—list the names 3

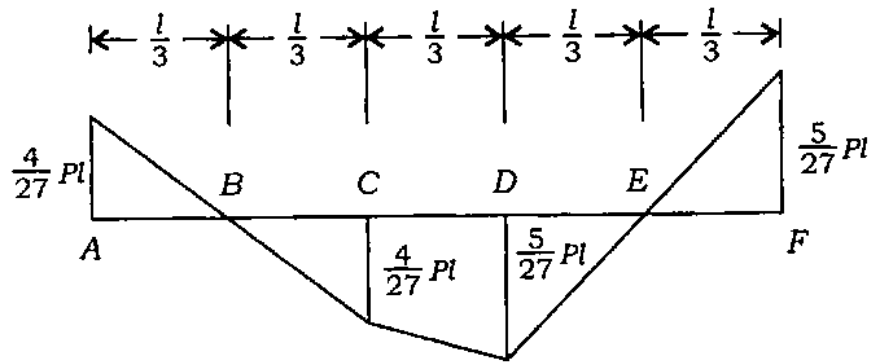
2. (a) A stepped bar with circular cross-section and supported at top, hangs vertically under its own weight. Dimensions of the bar are shown in the figure below. Calculate the elongation of the bar under its own weight. What is the change in diameter of the bar at section AA shown in the figure?  $E = 2 \times 10^5 \text{ N/mm}^2$ , density  $\gamma = 8 \times 10^{-5} \text{ N/mm}^3$  and Poisson's ratio  $\nu = 0.2$ .

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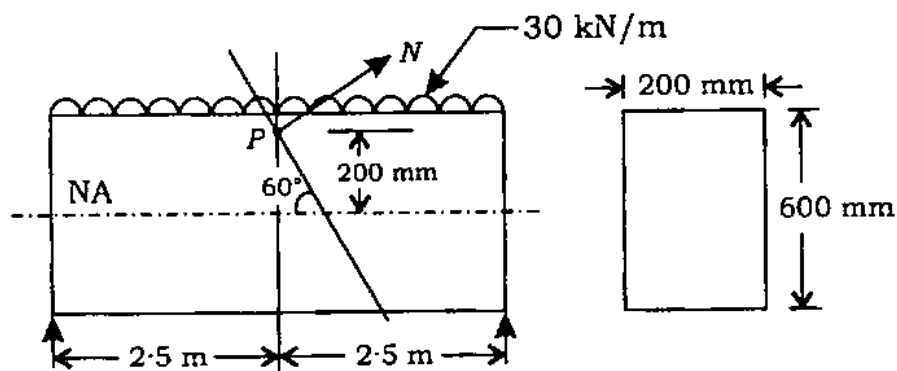
- (b) Bending moment diagram of a balanced cantilever beam is shown below. Draw the beam and find the loads acting on the beam.

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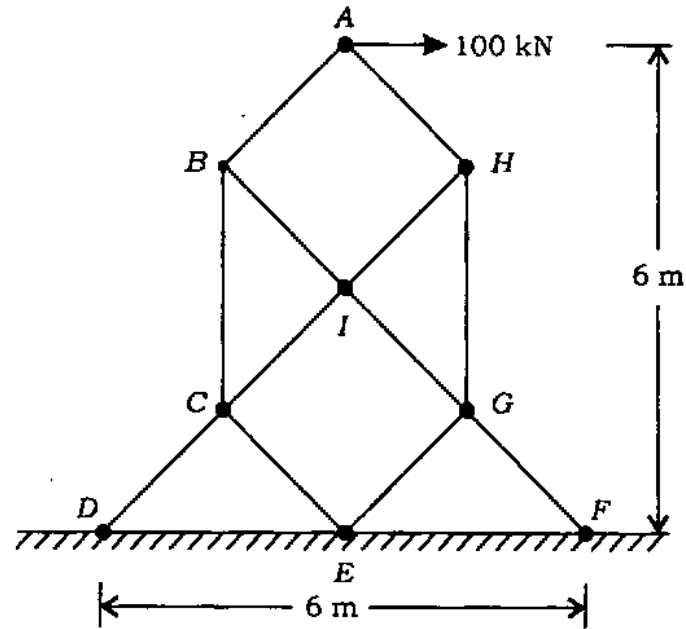
- (c) A simply supported beam of span 5 m and cross-section 200 mm × 600 mm is subjected to a uniformly distributed load of 30 kN/m including self-weight. A plane inclined at 60° to the axis of the beam is passing through a point *P* located on the central cross-section of the beam and 200 mm above the neutral axis. Find the normal stress and shear stress on the inclined plane at point *P*.

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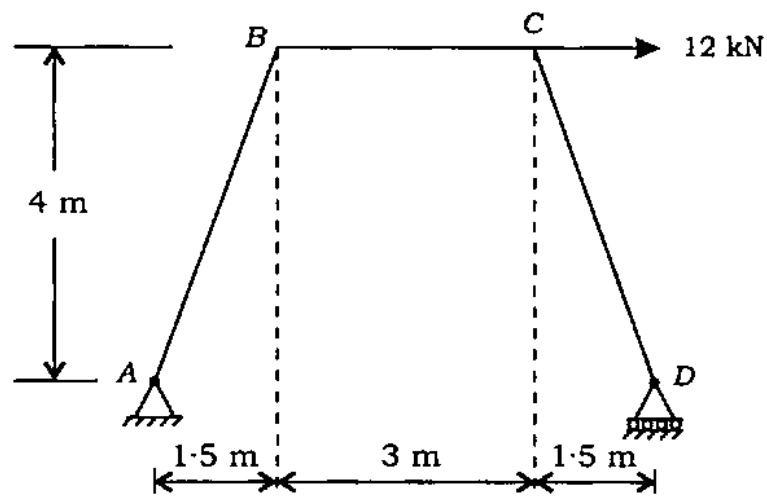
3. (a) Calculate the bar forces in all the members of the plane truss shown below which is used as a tower. All inclined members have a slope of  $45^\circ$  to the horizontal plane. Also, find reactions at supports  $D$ ,  $E$  and  $F$ .

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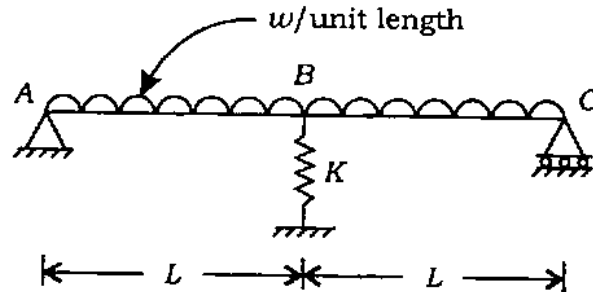


- (b) Find the reactions at supports  $A$  and  $D$  of the structure shown below. Draw BM diagram indicating BM values at salient points. Supports  $A$  and  $D$  are at the same level.

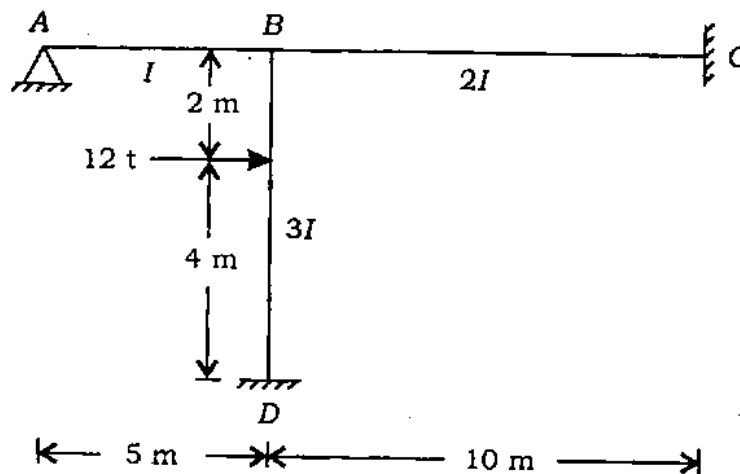
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- (c) Find the reaction at  $B$  for the beam shown below.  $K$  is the stiffness of spring at  $B$ . Beam is of constant section. Use energy method of analysis. 10



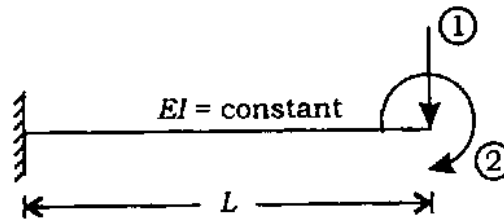
4. (a) Employing slope-deflection method, evaluate BM at salient points of the frame shown below. Draw BM diagram indicating BM values on it. 18



- (b) Define the terms 'plastic section modulus', 'shape factor' and 'load factor'. 6

Find the shape factor for a hollow tube section of external diameter  $D$  and internal diameter  $d$ . 6

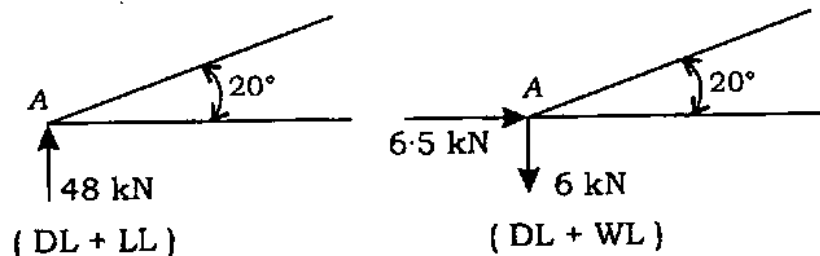
- (c) Develop the flexibility matrix for the cantilever beam for the degrees of freedom shown below. 10



5. (a) (i) Discuss the failure of rivets. 3  
 (ii) Explain why the design of compression member is done by indirect method. 5

- (iii) The joint A of a roof truss is shown below, where the main rafter and the main tie intersect. It is a hinged joint. It is subjected to end reactions as shown below : (1) Dead load + Live load and (2) Dead load + Wind load. Effective length of the main rafter is 2.83 m. Check the assumed section of the main rafter for its safety against compression.

Properties of the section assumed—double-angle back-to-back, angle being 80 mm × 50 mm × 10 mm having an area of 12.02 cm<sup>2</sup> each.  $r_{xx}$  of the double-angle section = 2.49 cm. 12



$l/r$	$f_c$ (kg/cm <sup>2</sup> )
0	1250
10	1246
20	1239
30	1224
40	1203
50	1172
60	1130
70	1075
80	1007
90	928
100	840
110	753
120	671
130	597
140	531
150	474
160	423
170	377
180	336
190	300
200	270
210	243
220	219
230	199
240	181
250	166
300	109
350	76

(b) (i) Explain the importance of welded connection in building connection. 5

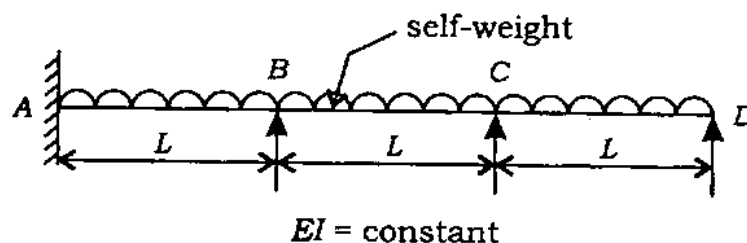
(ii) Design a single equal-angle tension member. It is 4 m long and subjected to a tensile load of 25 t. It is connected to a gusseted plate through one leg only. Assume rivet diameter of 18 mm.

$$\sigma_t = 1500 \text{ kg/cm}^2$$

Check for slenderness ratio. Given,  
 $\gamma_{\min} = 1.94$ . 15

6. (a) A pretensioned beam of size 250 mm × 350 mm prestressed by 12 wires of 7 mm diameter is initially stressed to 1200 N/mm<sup>2</sup> with the eccentricity located 100 mm from the soffit. Estimate the final loss of prestress due to elastic deformations, creep, shrinkage and relaxation. Given, relaxation of steel stress = 90 N/mm<sup>2</sup>,  $E_s = 210 \text{ kN/mm}^2$ ,  $E_c = 35 \text{ kN/mm}^2$ , creep coefficient ( $\phi$ ) = 1.6, residual shrinkage strain =  $3 \times 10^{-4}$ . 20

(b) (i) Sketch the elastic curve for the continuous beam as shown below. Sketch the reinforcement alignment. 5





- (ii) Design a T-beam for a commercial complex with reference to the data as stated below by working stress method : 15

Clear span of the T-beam = 10 m

Spacings of the T-beam = 2.5 m

Live load = 4 kN/m<sup>2</sup>

Thickness of the slab = 15 cm

Materials = M-20 grade concrete  
and Fe-415 HYSD bars

Effective span of the beam = 10.5 m

Assume the width of the rib  
= 300 mm

7. (a) A  $\frac{1}{2}$  cubic metre short boom dragline having ideal output of 150 m<sup>3</sup>/hr is to be used to excavate hard tough clay. The effect of the depth of cut of 5.0 m and angle of swing of 120° shall be 0.89. The operating factor shall be 50 min/hour. Determine the probable output of the dragline. 4

- (b) Indicate the performance of power shovel, backhoe, dragline and clam-shell for the following conditions in terms of very good, good, fair or poor : 6

- (i) Excavation in hard soil or rock  
(ii) Excavation in wet soil or mud  
(iii) Loading efficiency

- (c) A contractor intends to bid for a small-size civil engineering project consisting of the following activities and corresponding different time limits. Work out (i) critical path and standard deviation for the whole network, (ii) Z-factor for completing the project in 42 weeks, (iii) completion time duration for which the contractor should bid considering 93% probability assuming Z-factor as 1.5 and (iv) TF, FF and IF :

15

<i>Activity</i>	<i>Optimistic time</i> (in weeks)	<i>Most likely time</i> (in weeks)	<i>Pessimistic time</i> (in weeks)
1-2	1	3	5
1-3	3	6	15
2-3	2	5	14
2-4	5	7	9
3-4	2	4	12
2-5	6	9	18
4-5	1	2	3
3-8	3	12	15
4-6	4	6	8
5-7	1	2.5	7
6-8	3	4	5
6-7	0	0	0
7-9	1	8	9
9-10	1	3	5
8-10	0	0	0
8-11	1	9	11
10-11	3	4.5	9
9-11	4	9	20

(d) Determine the minimum cost and optimum duration for a project network. The duration and cost of each activity of the project is given in the following table. The indirect cost of the project is Rs 800 per day. Draw the time-scaled version of the network :

15

<i>Activity</i>	<i>Normal duration (in days)</i>	<i>Normal cost (in Rs)</i>	<i>Crash duration (in days)</i>	<i>Crash cost (in Rs)</i>
<i>A-B</i>	2	10,000	2	10,000
<i>A-C</i>	7	5,000	3	9,000
<i>B-C</i>	6	3,000	3	4,200
<i>B-D</i>	5	2,000	4	2,500
<i>C-D</i>	0	0	0	0
<i>C-E</i>	9	6,000	4	9,000
<i>D-F</i>	11	6,000	6	10,000
<i>E-F</i>	6	7,000	3	9,100

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