

ENGINEERING SERVICES  
EXAMINATION-2015

St

A-GTD-O-DDAA

**CIVIL ENGINEERING**

**Paper—I**

**(Conventional)**

*Time Allowed : Three Hours*

*Maximum Marks : 200*

**INSTRUCTIONS**

*Please read each of the following instructions carefully before attempting questions :*

*Candidates should attempt FIVE questions in all.*

*Question no. 1 is compulsory.*

*Out of the remaining SIX questions attempt any FOUR questions.*

*All questions carry equal marks. The number of marks carried by a part of a question is indicated against it.*

*Answers must be written in ENGLISH only.*

*Unless otherwise mentioned, symbols and notations have their usual standard meanings.*

*Assume suitable data, if necessary, and indicate the same clearly.*

*Neat sketches may be drawn, wherever required.*

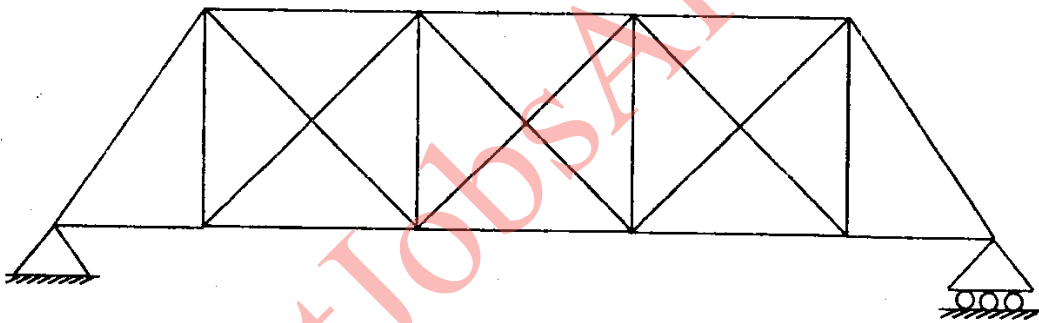
*All parts and sub-parts of a question are to be attempted together in the answer book.*

*Attempts of questions shall be counted in chronological order.*

*Unless struck off, attempt of a question shall be counted even if attempted partly.*

*Any page or portion of the page left blank in the answer book must be clearly struck off.*

1. (a) Give a detailed procedure for determining the compressive strength of bricks as per I.S. code. Also write about water absorption test. Mention the usual limit. 5
- (b) Find the total degree of statical indeterminacy (both internal and external) for the bridge truss shown in the figure. 5



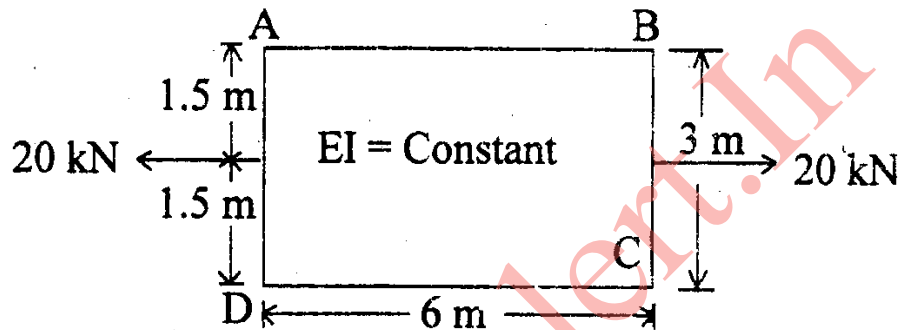
- (c) A propped cantilever beam of length 4 m is subjected to UDL of 30 kN/m over the entire length of the span. If the flexural rigidity of the beam is  $2 \times 10^4$  kN-m<sup>2</sup>, what would be the rotation at the propped support of the beam? Also determine the moment developed at the fixed support. 5

- (d) "In limit state method of design or working stress method of design, balanced neutral axis depth is not dependent on compressive strength of concrete." Justify the statement with the help of suitable formula. 5
- (e) List types of losses of pre-stress in pre-tensioning and post-tensioning systems. 5
- (f) A symmetrical three hinged parabolic arch has 40 m span and 5 m rise. A vertical downward load of 30 kN and a horizontal load of 20 kN (acting in the right hand side direction) act at one quarter span from left hand support. Determine reactions at the supports. 5
- (g) What is the principle of design of splice in a steel member subjected to an axial force ? Explain with the help of neat sketches. 5
- (h) Explain different types of vibrators and the application of each in construction works. 5

2. (a) Analyse the box-frame shown in the figure below by Moment Distribution Method.

Draw Bending Moment diagram with relevant values.

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- (b) A member in the plane truss is having the following data :  $L$  = length of the member;  $A$  = area of cross-section;  $E$  = Young's modulus of elasticity and  $\alpha$  = angle in the first quadrant from x-axis in anticlockwise direction.

Derive the element stiffness matrix of the plane truss member in local and global coordinate system.

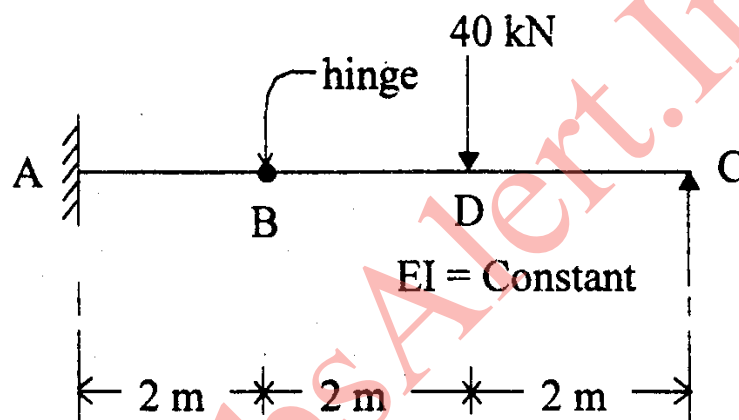
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- (c) A beam fixed at one end and simply supported at the other end is having a hinge at B as shown in the figure.

Determine the deflections (a) under the load and (b) at the hinge B.

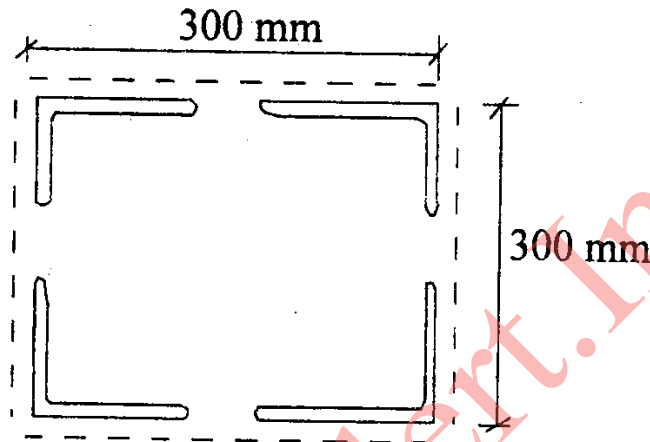
Use Moment Area Method.

10



3. (a) A column is made of 4 Nos. ISA  $100 \times 100 \times 10$  as shown. The effective length of column is 6 m. The lacing of column consists of  $60 \text{ mm} \times 10 \text{ mm}$  flat bars arranged in a single laced system by bolts and inclined at an angle of  $45^\circ$ . Determine the factored load on the column and check the local buckling of column angles. [ISA  $100 \times 100 \times 10$  :

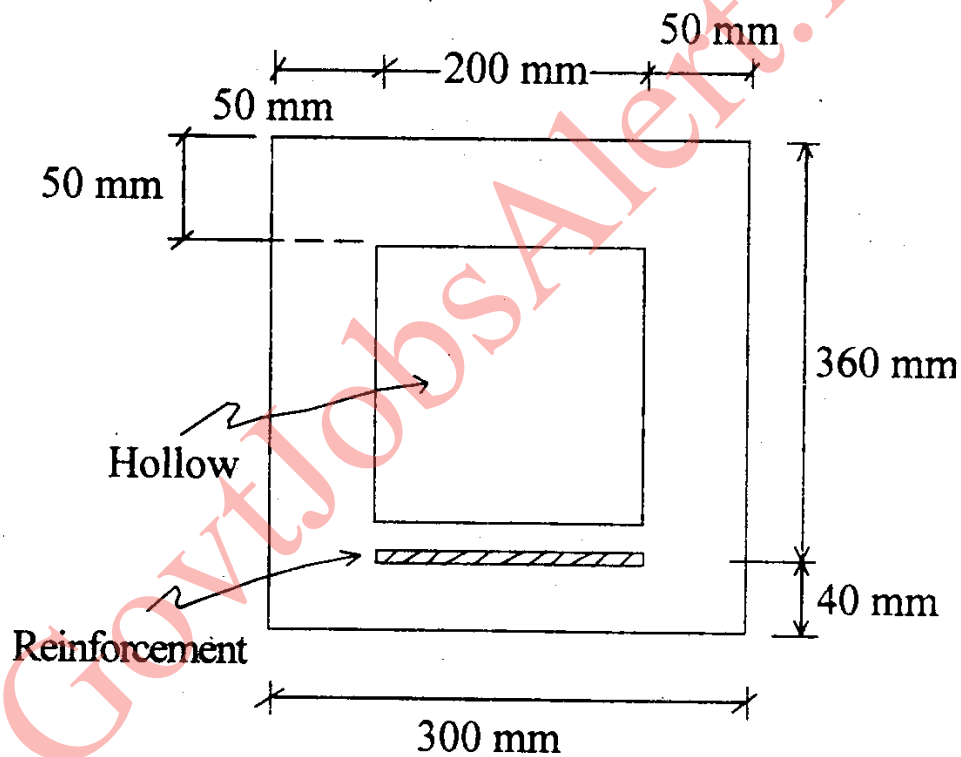
$A = 1903 \text{ mm}^2$ ,  $I_{XX} = I_{YY} = 177 \times 10^4 \text{ mm}^4$ ,  
 $C_{XX} = C_{YY} = 28.4 \text{ mm}$ ]. Assume gauge length =  
 55 mm and  $r_{vv} = 19.4 \text{ mm}$ . 20



KL/r	30	40	50	60	70	80	90
$f_{cd}$ (MPa)	204	185	167	150	133	118	105

- (b) A vertical cylindrical steel storage tank has 30 m diameter and the same is filled upto a depth of 15 m with the gasoline of relative density 0.74. If the yield stress for steel is 250 MPa, find the thickness required for the wall plate. Adopt a factor of safety of 2.5 and neglect localised bending effects, if any. 10

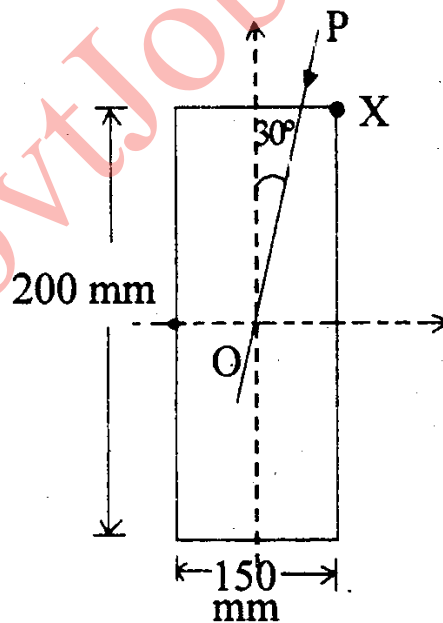
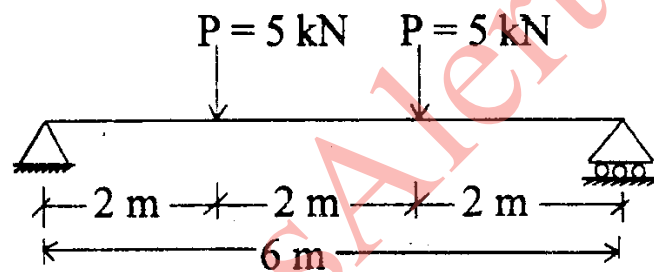
- (c) Determine the reinforcement required to resist a factored bending moment of 40 kN-m acting on a beam of hollow cross section as shown, using M 25 grade of concrete and Fe 415 steel. Effective depth of the beam is 360 mm. Adopt Limit State method of Design. 10



4. (a) A rectangular beam 150 mm wide and 200 mm deep, is simply supported on a span of 6 m. Two

loads of 5 kN each are applied to the beam, each load being 2 m from the supports as shown in the Figures. The plane of loads make an angle of  $30^\circ$  with the vertical plane of symmetry. Find the direction of neutral axis and the bending stress at a point marked 'X'.

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- (b) The vertical member of a triangular pratt truss is composed of 2 Nos. ISA 75 × 75 × 6 (connected back to back on each side of the gusset of 10 mm thickness). The factored forces in the member are :

107 kN (Compression)

79 kN (Tension)

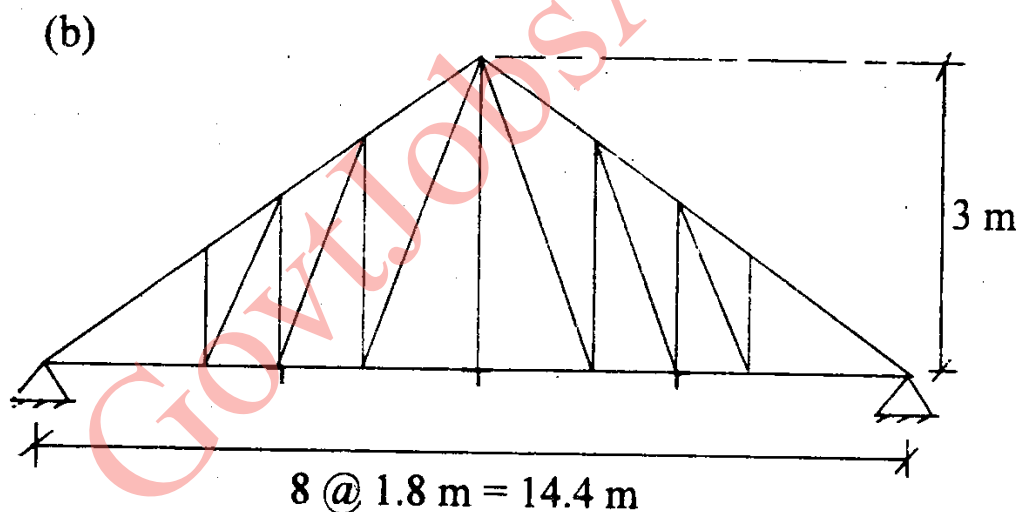
Design the fillet weld connection. Assume  $f_u = 410$  MPa and  $\gamma_{mw} = 1.25$ . Welding shall be done along the length of the member. 10

- (c) A PSC simply supported beam of length 4 m, width 200 mm and depth 200 mm is prestressed with a prestressing force of 200 kN. The beam is subjected to two concentrated loads of 10 kN each located 1 m from each support. Neglecting the dead weight of the beam, sketch the cable profile of the tendons for load balancing condition. Determine the maximum stress produced in the concrete. 10

5. (a) Two wheels, placed at a distance of 2.5 m apart, with a load of 200 kN on each of them, are moving on a simply supported girder (I-section) of span 6.0 m from left to right. The top and bottom flanges of the I-sections are  $200 \times 20$  mm and the size of web plate is  $800 \times 6$  mm.

If the allowable bending compressive, bending tensile and average shear stresses are 110 MPa, 165 MPa and 100 MPa respectively, check the adequacy of the section against bending and shear stresses. Self weight of the girder may be neglected.

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The bottom chord of the truss is composed of 2 Nos. ISA  $60 \times 60 \times 6$  with gusset thickness of

10 mm (back to back and both sides of the gusset).  
 Calculate the factored load carrying capacity of the member under compression only.

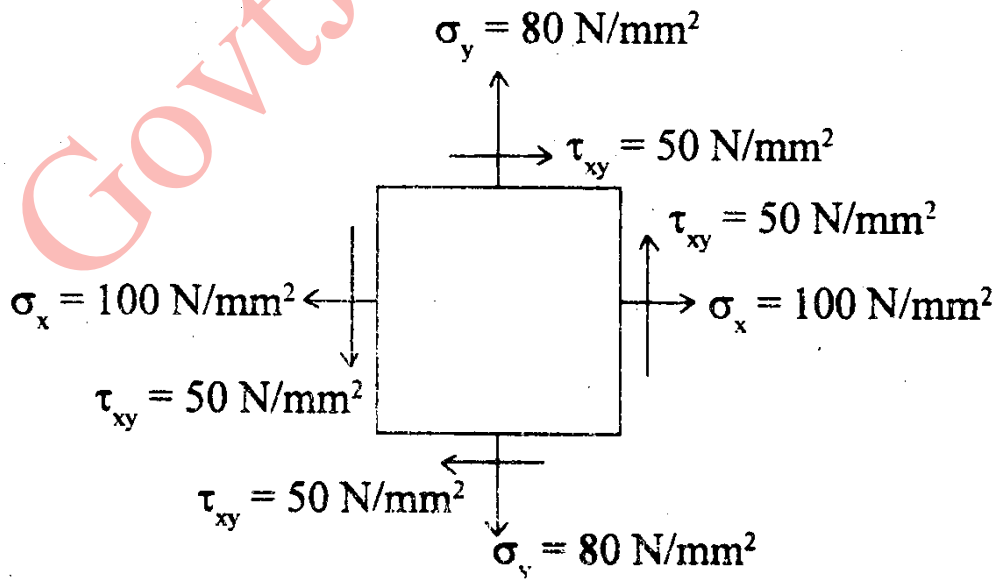
(ISA 60 × 60 × 6 : A = 684 mm<sup>2</sup>, I<sub>XX</sub> = I<sub>YY</sub> = 226000 mm<sup>4</sup>, C<sub>XX</sub> = C<sub>YY</sub> = 16.9 mm)

KL/r	80	90	100	110	120	130	140	150
f <sub>cd</sub> (MPa)	118	105	92.6	82.1	73	65.2	58.4	52.6

Longitudinal ties are provided at alternate node of the bottom chord.

What are High Strength Friction Grip Bolts ? State their advantages. 15+5

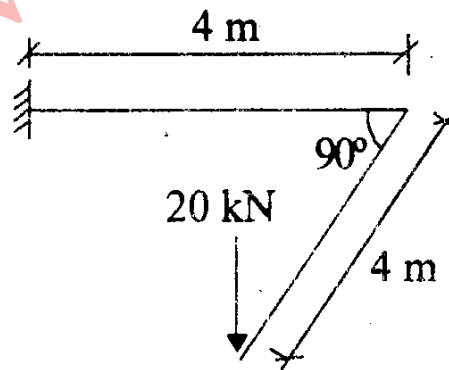
6. (a) A plane element of a body is subjected to stresses as shown in the figure.



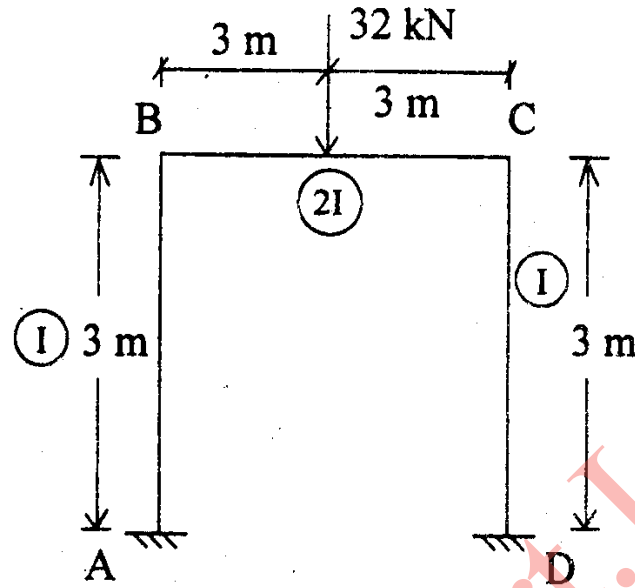
Find the factor of safety as per the following theories, if the yield stress given for the material is  $200 \text{ N/mm}^2$  and Poisson's ratio = 0.3 :

- (i) Maximum principal stress theory
- (ii) Maximum principal strain theory
- (iii) Maximum shear stress theory
- (iv) Maximum strain energy theory. 15

- (b) Draw the bending moment and torsional moment diagram for the beam as shown. The load is perpendicular to the beam in plane. 5



(c)



In the rigid frame shown in figure A central concentrated load is acting on "BC". Find slopes

$\theta_A, \theta_B, \theta_C, \theta_D$  10

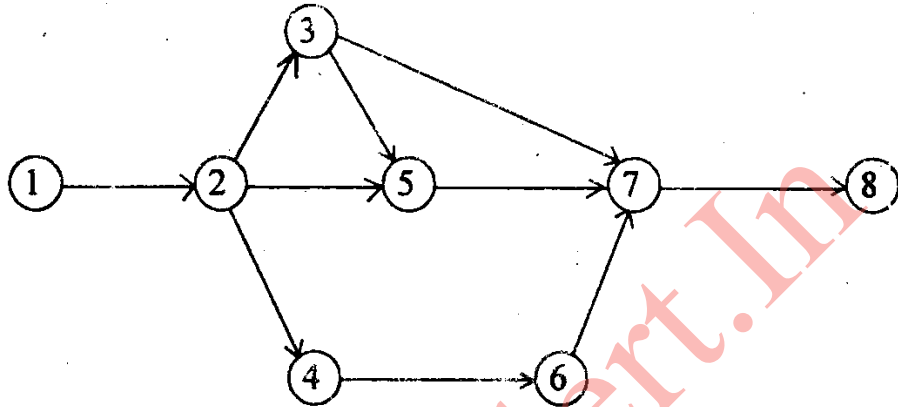
(d) Discuss the stress-strain curve of steel of grade Fe 500 and its application under Plastic Analysis.

5+5

7. (a) For the network of a construction project with various activities shown below, determine the

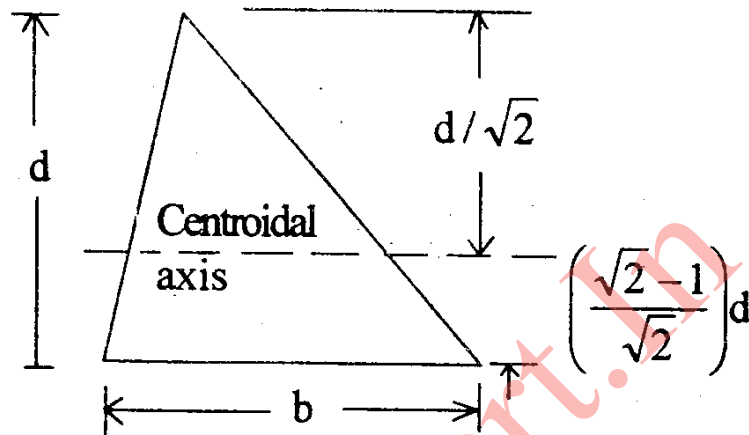
project completion time. Determine the total float of each activity. Mention the critical activities.

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Activity	Duration (weeks)
1—2	16
2—3	24
2—4	36
2—5	8
3—5	12
4—6	40
3—7	32
5—7	8
6—7	16
7—8	12

- (b) Find the shape factor for a triangular section as shown in the figure. 10



- (c) (i) Define critical path.  
(ii) What is direct cost slope ?  
(iii) Explain FLOAT and slack. 10