22607

12223

4 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions : (1) All Questions are *compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(8) If not mentioned, assume fy = 250 MPa, fu = 410 MPa.

Marks

1. Attempt any FIVE of the following : 10

(a) List any two types of failures in case of tension member and draw a neat sketch of any one.

(b) Sketch any two combinations of sections used as built-up column.

(c) Write the conditions for formation of T or L beams.

(d) State four types of stairs from design point of view.

(e) State the effective span of stairs where the landing slab spans in the same direction as that of steps.

(f) State values of intensity of live load in case of residential and school building, to be used for design of stair slab.

(g) State the parameters that affect local buckling in compression member.

2. Attempt any THREE of the following : 12

(a) The longer leg of a single angle 90 mm × 60 mm × 10 mm is connected to the gusset plate with 3 bolts (in a row) of 20 mm diameter at a pitch of 60 mm and edge distance of 40 mm. Determine block shear strength only.

(b) Calculate the effective flange width for T-beam for following details :

Width of web = 230 mm

Slab thickness = 100 mm

Size of hall = 12 m × 6 m

Width of support for beam = 230 mm

Centre to centre of beams = 3 m

(c) Design a circular column to carry an axial load of 1500 kN using mild steel lateral ties. Use M25 concrete and Fe415 steel. The unsupported length of column is 3.75 m.

(d) A rectangular column 600 mm × 450 mm having an unsupported length of 3 m. Check the column for minimum and maximum eccentricity.

3. Attempt any TWO of the following : **12**

(a) The tension member of a truss consists of 2 ISA 70 × 70 × 6 mm connected on the same side of a 10 mm thick gusset plate. Take diameter of bolt is 20 mm thick & area of single angle is 806 mm^2. Determine the design tensile strength of member. (Block shear strength not expected)

(b) Design a tension member to carry an axial service load of 300 kN. Double angle sections placed back to back and connected with their longer legs on the same side of gusset plate with 16 mm diameter bolt and 4.6 grades. The properties of single angle are as follows :

Angle Section	Cross Sectional Area (mm^2)	Thickness (mm)
ISA 60 × 40	737	8
ISA 65 × 45	817	8
ISA 100 × 75	1336	8
ISA 125 × 75	1538	8
ISA 150 × 75	1748	8

(c) A single angle ISA 90 × 90 × 8 mm is used as a strut in a roof truss. The centre to centre distance between intersection points at each end is 2.75 m. The ends of the member are fixed and connected by welds. Calculate design strength. Take $f_y = 250\ N/mm^2$.

Take, $A = 1379\ mm^2$

$r_{min} = r_{vv} = 17.5$ mm

$K_1 = 0.20$

$K_2 = 0.35$

$K_3 = 20$

$\alpha = 1.271$

4. Attempt any TWO of the following : 12

(a) A discontinuous double angle strut consists of 2 ISA 75 × 75 × 8 mm, having $A = 1138\ mm^2$, $I_{xx} = I_{yy} = 59 \times 10^4\ mm^4$, $r_{yy} = r_{xx} = 22.8$ mm, $C_{xx} = C_{yy} = 21.4$ mm.

The angle section is welded back to back on each side of gusset plate 10 mm thick. Calculate the design strength of the strut.

(b) Draw a neat sketch of lacing system and state any three requirements of lacing to be used.

(c) A beam having dimensions of 250 × 500 mm (effective) is reinforced with 4 bars of 16 mm diameter on tension side and 3 bars of 12 mm diameter on compression side.

Calculate the ultimate moment of resistance of the beam if M20 grade concrete and Fe415 steel is used. Take d' = 50 mm and fsc = 345 N/mm^2.

5. Attempt any TWO of the following : 12

(a) Design a rectangular beam for an effective span of 6 m. The superimposed load is 80 kN/m and size of the beam is limited to 300 × 700 mm overall.

Use M20 and Fe415. Assume a cover of 40 mm.

Use following table for the calculation of 'fsc'.

$\frac{d'}{d}$	0.05	0.10	0.15	0.20
fsc	355	352	342	329

(b) A doubly reinforced beam has width 250 mm and overall depth 480 mm. Area of compression steel is 452 mm^2. Calculate total area of tension steel. Effective cover to bars is 40 mm. Take fsc = 353 MPa. Use M25, Fe415.

(c) Find ultimate moment of resistance of a ell beam with the following data :

Width of flange = 1500 mm

Width of web = 300 mm

Effective depth = 600 mm

Slab thickness = 100 mm

Area of Tensile steel = 4500 mm^2

Use M20 and Fe415.

6. Attempt any TWO of the following : 12

(a) Design the mid span of a T-beam to carry imposed load of 4 kN/m^2. The beams are spaced 2.5 m centre to centre and the effective span of the beam is 5 m. The slab thickness is 100 mm and ribs below the slab are 200 mm wide and 450 mm deep. The slab and beam are casted together. Use M20 & Fe415. Assume floor finish as 1 kN/m^2.

(b) Design an RC stair shown in Fig. No. 1 with the following data :

(i) Rise = 150 mm

(ii) Live load = 5 kN/m^2

(iii) Tread = 250 mm

(iv) M20 & Fe500 grades

Landing thickness = 200 mm

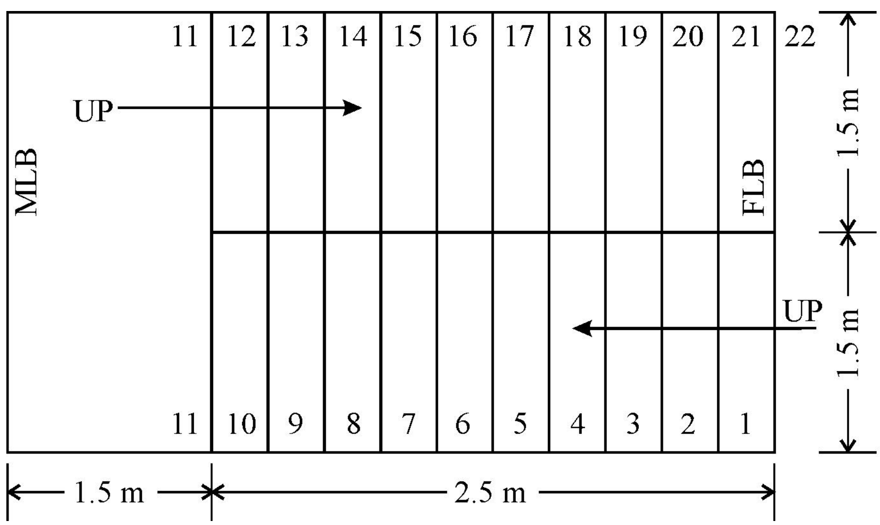

Fig. No. 1

(c) Design a rectangular column footing of uniform depth with the following data. Column size = 300 × 400 mm, load on column = 1200 kN, permissible load on soil = 20 kN/m^2. Check for shear not expected.

Draw plan showing reinforcement.

FORMULAE SHEET

(I.S. 800-2007)

$$f_{cd} = \frac{\frac{fy}{\gamma mo}}{\emptyset + \sqrt{\emptyset^2 - \lambda^2}} = \frac{\chi fy}{\gamma mo} \leq \frac{fy}{\gamma mo} \quad , \quad \emptyset = 0.5\,[\,1 + \alpha(\lambda - 0.2\,) + \lambda^2]$$

$$\lambda = \sqrt{\frac{fy}{fcc}} = \sqrt{\frac{fy\left(\frac{KL}{r}\right)^2}{\mu^2 E}} \quad , \chi = \frac{1}{\emptyset + \sqrt{\emptyset^2 - \lambda^2}} \quad , \lambda_e = \sqrt{\left(k_1 + k_2\lambda_{vv}^2 + k_3\lambda_{\emptyset}^2\right)}$$

$$\lambda_{vv} = \frac{\frac{1}{r_{vv}}}{\varepsilon\sqrt{\frac{\mu^2 E}{250}}} \quad \text{and} \quad \lambda_e = \frac{\left(\frac{b_1 + b_2}{2t}\right)}{\varepsilon\sqrt{\frac{\mu^2 E}{250}}} \quad , \quad T = A_n \cdot f_u$$

$$T_{dn} = \frac{T}{\gamma_{m1}} = \frac{A_n \cdot f_u}{\gamma_{m1}} \quad , \quad T_{dn} = 0.9\frac{A_{nc}\, f_u}{\gamma_{m1}} + \beta\frac{A_{go}\, f_y}{\gamma_{mo}}$$

$$\beta = 1.4 - 0.076\frac{W}{t} \times \frac{f_y}{f_u} \times \frac{b_s}{L_c}, \quad T_{db_1} = \frac{A_{vg} \cdot f_y}{\sqrt{3}\,\gamma_{mo}} + 0.9\frac{A_{tn}\, f_u}{\gamma_{m1}}$$

$$T_{db_2} = \frac{A_{tg} \cdot f_y}{\gamma_{mo}} + 0.9\frac{A_{vn}\, f_u}{\sqrt{3}\,\gamma_{m1}}$$