22607

23242

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

Marks

1. Attempt any FIVE of the following : 10

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

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

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

(d) List two end conditions of column along with their equivalent length.

(e) State the parameters that affects local buckling in compression member.

(f) State conditions for providing doubly reinforced beam.

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

2. Attempt any THREE of the following : 12

(a) Design a tension member consisting of single unequal angle connected to gusset plate of 12 mm thick to carry a factored tensile load of 300 kN. Assume single row of 20 mm bolted connection length of member is 2.5 m. (fu = 415 MPa)

Section (mm)	ISA 100 × 75 × 8	ISA 125 × 75 × 8	ISA 150 × 75 × 8
Area (mm^2)	1336	1588	1748

(b) Calculate effective flange width of T-beam width of web = 230 mm, Slab thickness = 100 mm, Size of hall = 12 m × 6 m, Width of support beam = 230 mm C/C 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 4 m high column is effectively held in position at both ends and restrained against rotation at one end. If diameter of column is restricted to 420 mm. Calculate reinforcement to carry a factored axial load of 2000 kN. Use M20 grade concrete and Fe415 steel.

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

(a) Determine tensile strength of a roof truss member. 2 ISA 90 × 60 × 6 mm connected to gusset plate of 8 mm by 18 mm diameter bolts.

(b) Design a tension member to carry an axial service load of 210 kN. Double angle section with gusset plate in between is to be used. Bolts of 16 mm diameter and 4.6 grade are to be used.

Angle sections are available.

(c) A discontinuous strut 3.2 m long of a roof truss consists of double-angle section 90 × 90 × 8 mm connected to 10 mm gusset plate. Calculate total load carrying capacity.

ISA 90 × 90 × 8 mm, $F_y = 250\ N/mm^2$, $A = 1380\ mm^2$

$C_{xx} = C_{yy} = 25.1$ mm, $r_{xx} = r_{yy} = 27.5$ mm, $r_{vv} = 17.5$ mm

$I_{xx} = I_{yy} = 104 \times 10^4\ mm^4$

kL/r	80	90	100	110	120	130
Fcd (N/mm^2)	136	121	107	94.6	83.7	74.4

4. Attempt any TWO of the following : 12

(a) Design principal rafter of roof truss carrying a service load of 200 kN in compression and having c/c length of 2.36 m between joints. Thickness of gusset plate may be taken as 10 mm. Angle sections available are –

ISA 9060 × 8 mm, ISA 9060 × 10 mm, ISA 8050 × 10 mm

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

(c) Calculate area of steel required for RCC sections 200 × 450 mm effective to resist an ultimate B.M. of 150 kN·m [Assume M30 concrete and Fe415 steel]

5. Attempt any TWO of the following : 12

(a) Find ultimate moment of resistance of beam –

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)

(b) Design an R.C. stair, shown in Fig. No. 1.

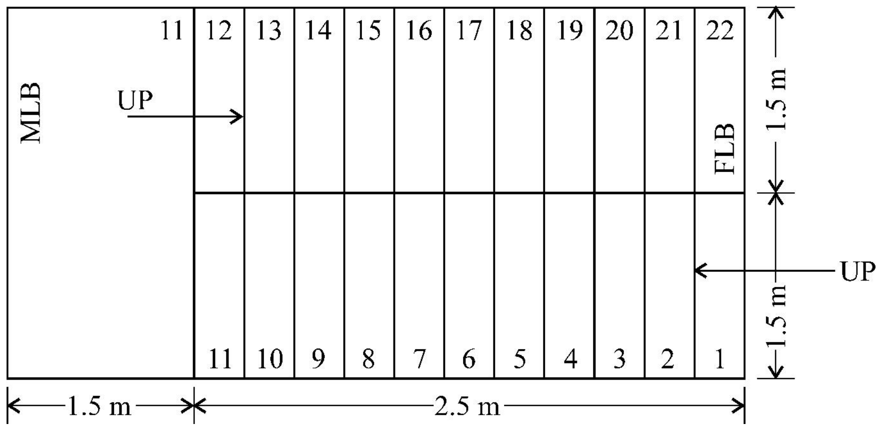

Fig. 1

Rise = 150 mm, Tread = 250 mm, Live load = 5 kN/m^2 (M20 & Fe500 grade)

Landing Thickness = 200 mm.

(c) Calculate area of steel in singly reinforced flanged beam

Effective span = 6 m, Spacing of T beam ribs = 2.75 m, Live Load = 40 kPa, Slab Thickness = 100 mm. Use M20 & Fe415 steel.

6. Attempt any TWO of the following : 12

(a) Design midspan of T beam carry imposed load of 4 kN/m^2. The beams are spaced 2.5 m centre to centre and effective span of beam is 15 m. The slab thickness is 100 mm and ribs below slab are 200 mm wide & 450 mm deep. The slab and beam are casted together. Use M20 & Fe415 (Floor finishes = 1 kN/m^2).

(b) A doubly reinforced beam 230 × 600 mm (overall) has to carry a factored moment of 150 kN·m. Calculate amount of steel required on compression side and tensile side, if cover on B.S. is 40 mm. Use M15 concrete and grade I Mild Steel.

(c) Design a column footing for following :

(1) Load on column = 600 kN

(2) Size of column = 200 mm × 300 mm

(3) Safe Bearing Capacity of soil = 150 kN/m^2.

Use M20 mix and Fe415 steel; Check for two way shear may not be taken.

FORMULAE SHEET

(I.S. 800-2007)

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

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

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

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

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

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