BCE-041

Diploma in Civil Engineering

Term-End Examination

June, 2008

BCE-041 : THEORY OF STRUCTURES II

Time : 2 hours *Maximum Marks : 70*

Note : *Attempt Question No. 1 which is* ***compulsory*** *and any other* ***three*** *questions. Assume suitable data wherever necessary and mention it clearly. Design data given at the end may be used wherever required.*

---

1. Choose the most appropriate answer from the given alternatives : *5×2=10*

(i) Maximum depth of neutral axis ($x_{u\,max}$) for RCC flexural member in Limit State Design for Fe 250 grade of steel is

(a) 0·53 d

(b) 0·48 d

(c) 0·46 d

(d) 0·43 d

(ii) The maximum horizontal distance between parallel main reinforcement bars in a slab shall be

(a) 300 mm

(b) three times the effective depth of slab

(c) greater of (a) and (b)

(d) smaller of (a) and (b)

(iii) Basic values of span to depth (upto span 10 m) to control deflection of RCC flexural member in Limit State Method, for the case of cantilever beam shall be

(a) 20

(b) 10

(c) 7

(d) 26

(iv) Maximum spacing of shear reinforcement for vertical stirrups in a beam shall be

(a) 0·75 × effective depth of the beam

(b) 300 mm

(c) smaller of (a) and (b)

(d) greater of (a) and (b)

(v) The maximum longitudinal reinforcement in a column is provided as a percentage of gross-sectional area of the column. This percentage is

(a) 0·8

(b) 4

(c) 6

(d) 8

2. A rectangular RC beam of 250 mm × 450 mm (effective depth) has tensile reinforcement of 3 bars of 16 mm ϕ. Evaluate neutral axis depth if the permissible stress in steel (σ_{st}) is 230 N/mm^2 and in concrete (σ_{cbc}) is 7 N/mm^2. Also determine safe moment of resistance of this section. *20*

3. Design a simply supported rectangular beam having a clear span of 6 m. The beam has to carry a superimposed uniformly distributed load of 20 kN/m including its self weight. Adopt support width of 300 mm, M 20 concrete, Fe 415 steel for main tension reinforcement and Fe 250 steel for shear reinforcement. *20*

4. A 'T' beam (figure 1) of 7 m clear span is simply supported on 250 mm thick walls. This beam has to carry a uniformly distributed load of 40 kN/m (excluding its self weight). Design the tension reinforcement for the beam adopting Fe 415 grade steel and M 25 grade concrete. 20

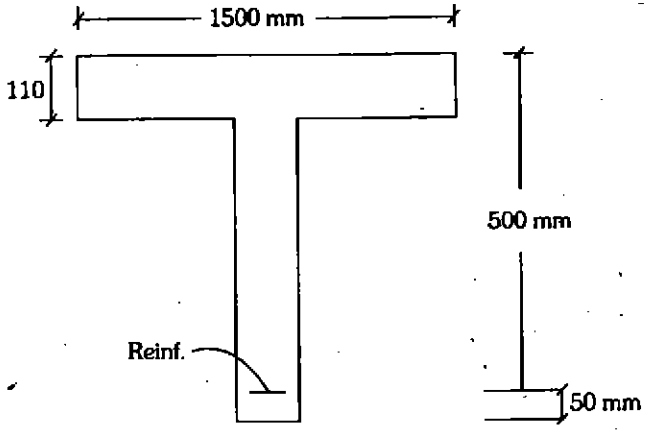

Figure 1

5. A rectangular beam of section 300 mm × 500 mm (total depth) is to resist factored bending moment of 90 kN-m, factored torsional moment 20 kN-m and factored shear force 90 kN. Determine the longitudinal and tranverse reinforcement. Adopt concrete of M-20 grade, steel of grade F 415 and effective concrete cover of 50 mm. 20

6. Design a suitable reinforced concrete footing for a square column of size 400 mm × 400 mm. The column is reinforced with 8 bars of 25 mm diameter and carrying a factored axial load of 2200 kN. The safe bearing capacity of soil at the site is 250 kN/m^2. Adopt M-20 grade of concrete and Fe 415 grade of steel. *20*

7. Design waist slab of the first flight of a stairs in a building. Number of steps in this flight are 12 with tread of 300 mm, riser of 160 mm and width of landing 1·2 m. The slab is carrying an imposed load of 4 kN/m and is supported on walls of thickness 250 mm at both of its ends in the span direction. Adopt M-20 grade of concrete and Fe 415 grade of steel. *20*

8. Write short notes on any ***five*** of the following : *5×4=20*

   (a) Retaining wall

   (b) Over reinforced and under reinforced section in Limit State Design

   (c) Implication of slenderness ratio in the design of compression members

   (d) Why water tanks are designed by Working Stress method ?

   (e) Advantages of providing concrete cover to reinforcement in flexural members

   (f) Assumptions in Limit State of Collapse : Flexure

***Note** : The following design data may be used wherever required.*

A. Design Shear Strength of Concrete τ_c, N/mm^2 (Limit – State Method).

100 A_{st} / bd	Concrete M-20	Concrete M-25
0·15	0·28	0·29
0·25	0·36	0·36
0·50	0·48	0·49
0·75	0·56	0·57
1·00	0·62	0·64
1·25	0·67	0·70
1·50	0·72	0·74
1·75	0·75	0·78
2·00	0·79	0·82
2·25	0·81	0·85
2·50	0·82	0·88
2·75	0·82	0·90

B. Design Bond stress τ_{bd} N/mm^2 (Limit – State Method) for bars in tension.

	Steel Fe 250	Steel Fe 415
Concrete M-20	1·20	1·92
Concrete M-25	1·40	2·24

C. Design Shear Strength of Concrete $\tau_{c\ max.}$ N/mm^2 (Limit – State Method)

Concrete M-20 2·8

Concrete M-25 3·1

D. For solid slabs, design shear strength of concrete shall be taken as K τ_c. Values of K are as below :

Overall depth of slab (mm)	K
300 or more	1·00
275	1·05
250	1·10
225	1·15
200	1·20
175	1·25
150 or less	1·30

E. Modification factor K_2 for different percentages of tension reinforcement A_{st} in flexural RCC members for stress in steel at service loads, f_s = 240 N/mm^2, may be taken as below :

100 A_{st} / bd	K_2
0·2	1·7
0·4	1·32
0·6	1·15
0·8	1·05
1·0	1·0
1·2	0·95
1·4	0·90
1·6	0·88
1·8	0·86
2·0	0·84
2·2	0·82
2·4	0·88
2·6	0·79
2·8	0·78