Diploma in Civil Engineering

Term-End Examination

December, 2007

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.*

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 method for Fe 415 grade of steel is

(a) 0·43 d

(b) 0·53 d

(c) 0·48 d

(d) 0·46 d

(ii) Basic values of span to depth (upto span 10 m) to control deflection of RCC flexural members in Limit State Method for the case of simply supported beam is

(a) 20

(b) 7

(c) 10

(d) 26

(iii) The minimum distance between two parallel reinforcement bars in a RCC member shall be

(a) Diameter of largest bar

(b) 5 mm more than nominal maximum size of coarse aggregate

(c) Greater of (a) and (b)

(d) Smaller of (a) and (b)

(iv) Maximum tension reinforcement in a beam as a percentage of the gross-section area shall be

(a) 2

(b) 4

(c) 5

(d) 6

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

(a) 300 mm

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

(c) Greater of (a) and (b)

(d) Smaller of (a) and (b)

2. A rectangular beam of clear span of 6 m is simply supported on 300 mm wide supports. This beam has to carry uniformly distributed load of 15 kN/m excluding its self weight. Design the beam using M-20 grade of concrete, Fe 415 grade of steel for both tension and shear reinforcement. *20*

3. An RC beam of 4·5 m effective span and section of 300 mm and 500 mm (overall depth) is reinforced with 2 bars of 16 mm ϕ and 1 bar of 12 mm ϕ. Check whether beam is under reinforced or over reinforced assuming permissible stress in steel (σ_{st}) as 230 N/mm^2 and that in concrete (σ_{cbc}) as 7 N/mm^2 and effective concrete cover of 50 mm. Also determine the permissible U.D.L. inclusive of its self weight, if beam is simply supported. *20*

4. Design longitudinal and transverse reinforcement for a rectangular beam of 300 mm and 450 mm (effective depth). This beam is to resist a factored bending moment of 110 kN-m, factored torsional moment 10 kN-m and factored shear force 110 kN. Adopt M-20 grade of concrete and Fe 415 grade of steel. *20*

5. Design the reinforcement for a column of size 400 mm × 600 mm subjected to an axial load of 1800 kN. The column has un-supported length of 3·5 m and its both ends are effectively held in position and restrained against rotation. Adopt M-20 grade of concrete and Fe 415 grade of steel. *20*

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

(a) Various types of staircases
(b) Design of underground circular tank
(c) Two way shear in RCC footing
(d) Limit state of serviceability
(e) Development length
(f) Effective flange width of 'T' beam

7. Determine the permissible U.D.L. inclusive of its self weight for 'T' beam section (Figure 1). This beam has effective span of 7·5 m and is simply supported on both ends. Adopt M-25 grade of concrete and Fe 415 grade of steel. *20*

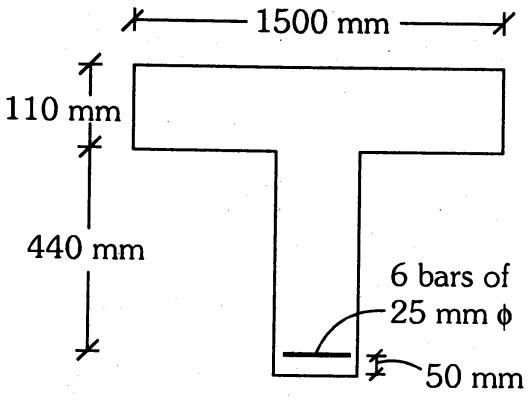

Figure 1

8. Design a slab for a residential floor of clear size 4·5 m × 5·5 m. This slab is simply supported on all sides on masonry walls of 300 mm thickness. Imposed load on the slab is 2 kN/m^2 and the corners are prevented from lifting. Adopt M-20 grade of concrete and Fe 415 grade of steel. *20*

Type of panel Four edges discontinued	Short span coefficients α_x Values of l_y/l_x								Long span coeff. α_y for all values of l_y/l_x
Positive moments at mid span	1·0	1·1	1·2	1·3	1·4	1·5	1·75	2·0	0·056
	0·056	0·064	0·072	0·079	0·085	0·089	0·100	0·107	

***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. The 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