Diploma in Civil Engineering

Term-End Examination

June, 2010

BCE-041 : THEORY OF STRUCTURES II

Time : 2 hours *Maximum Marks : 70*

Note : *Question number 1 is* ***compulsory****. Attempt any other* ***four*** *questions. In all, solve* ***five*** *questions. All questions carry* ***equal*** *marks. Assume suitable data wherever necessary and mention it clearly. Use of calculator is allowed.*

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1. Choose the most appropriate answer from the given alternatives : **7x2=14**

   (a) In limit state method of design of RCC. Flexural members, the centre of gravity of the compressive forces acting on the section, from the topmost fibre of concrete, is at a distance of :

   (i) 0.57 the depth of neutral axis

   (ii) 0.36 the depth of neutral axis

   (iii) 0.42 the depth of neutral axis

   (iv) None of these

(b) The minimum reinforcement in a slab is provided as a percentage of the gross area of the section. This percentage for grade of steel Fe 250 is :

(i) 0.15 (ii) 0.20

(iii) 0.25 (iv) 0.10

(c) Let the maximum compression reinforcement in a beam be p% of the gross area of section of the beam. The value of p shall be :

(i) 1 (ii) 2

(iii) 3 (iv) 4

(d) In Limit State Method of design of flexural members, the neutral axis depth coefficient for a balanced section for steel of grade Fe 415 is :

(i) 0.53 (ii) 0.58

(iii) 0.48 (iv) 0.46

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

(i) Diameter of the largest bar.

(ii) 5 mm more than the nominal maximum size of coarse aggregate.

(iii) Greater of (i) or (ii)

(iv) Smaller of (i) and (ii)

(f) The characteristic yield strength of steel reinforcement is represented by f_y. The design strength of steel reinforcement (f_d), at collapse in limit state Method of design, is taken as :

(i) f_y (ii) $0.67\, f_y$

(iii) $0.45\, f_y$ (iv) $0.87\, f_y$

(g) The pitch of helical ties in a circular column shall be not less than :

(i) 50 mm

(ii) Three times the diameter of the bar of helical tie.

(iii) 25 mm

(iv) Greater of (ii) and (iii)

2. A reinforced concrete rectangular beam of size 350 mm × 500 mm is reinforced with 5 bars of 20 mm diameter of grade Fe 415. Assume nominal cover of 20 mm, shear reinforcement of 8 mm diameter and concrete of grade M20. Using Limit - State method of design :

(a) Check whether the section is under - reinforced, balanced or over - reinforced. 7

(b) Calculate safe moment of resistance (Mu) for the beam. 7

3. A reinforced concrete rectangular beam of size 300 mm × 550 mm is reinforced with 4-bars of 20 mm diameter of grade Fe 250. Assume an effective cover of 50 mm, and concrete of grade M 20. Using Working - Stress method of design, taking $\sigma_{bc} = 7\ N/mm^2$, $\sigma_{st} = 140\ N/mm^2$ and $m = 13$.

   (a) Check whether the section is under - reinforced balanced or over - reinforced. 7

   (b) If this section resists a moment of 45 KNm find stresses in concrete and tensile reinforcement. 7

4. Design the longitudinal as well as transverse reinforcement for a rectangular beam of width 300 mm and an overall depth of 500 mm. Use steel of grade Fe 415, concrete of grade M25 and an effective cover of 50 mm. 14

   Ulitimate Bending Moment $M_u = 100$ KNm.

   Ultimate Shear force $V_u = 100$ KN.

   Ultimate tensional Moment $T_u = 9$ KNm.

5. Design the longitudinal reinforcement and transverse reinforcement for a circular reinforced concrete column of diameter 300 mm and carrying a factured load of 1200 KN. The unsupported length of the column is 3.0 m with both ends effectively held in position but not restrained in against rotation. Adopt steel of grade Fe 415 and concrete of grade M20. 14

6. A T-beam floor of an office consists of a slab 150 mm thick, spanning between ribs spaced at 3.0 m c/c. The effective span of the beam is 8 m. Live load on the floor is 4 KN/m^2. Load due to floor finish can be assumed as 1.0 KN/m^2. Use M20 concrete and steel Fe 415. Design one of the intermediate beams. **14**

7. Describe various types of stair cases with the help of neat sketches. **14**

8. Write short notes *any four* of the following : **4x3½=14**

   (a) Shear reinforcement.

   (b) Basic Assumptions for the design of sections by Working Stress method.

   (c) Limit state of collapse.

   (d) Critical sections for bending moment and shear in column footings.

   (e) Principles of slab design.

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

(a) Design Shear strength τ_c of concrete in N/mm^2 (Limit-State method) :

100 A_{st} / bd	**Concrete M20**	**Concrete M25**
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
0.25	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 M20	1.20	1.92
Concrete M25	1.40	2.24

(c) Design shear strength of concrete τ_c max. N/mm^2 (Limit-State method).

Concrete M20 2.8

Concrete M25 3.1

(d) For solid slabs, design shear strength of concrete shall be taken as $K \tau_c$. The values of K are as below :

Overall depth of slab (mm)	K
300 or more	1.00
275	1.105
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	0.80
2.6	0.79
2.8	0.78