53 (CE 501) DGST-I

2016

DESIGN OF STRUCTURE-I

Paper : CE 501

Full Marks : 100

Time : Four hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. (a) Why is it undesirable to design over-reinforced sections in working stress method and limit state method ?

   3

   (b) Explain how the neutral axis is located in T-beam sections, given that it lies outside the flange.

   2

(c) A beam carries a uniformly distributed service load (including self weight) of $40 kN/m$ on a simply supported span of $7 \cdot 0m$. The cross-section dimensions of the beam are width $= 200 mm$, total depth $= 700 mm$, effective depth $= 650 mm$ and it is reinforced with 4 numbers of $25 mm$ diameter tensile bars. Assuming $M20$ concrete and $Fe415$ steel, compute

   (i) the stresses developed in concrete and steel at applied service loads,

   (ii) ultimate moment of resistance

   (iii) the effective load factor, considering the service load of $40 kN/m$.   15

2. (a) Can the use of excessive cement in concrete be harmful ? Explain in brief.

                                                          2

(b) A doubly reinforced section is shown in *Figure* 1. Assuming $M20$ concrete and $Fe\,415$ steel, determine the ultimate moment of resistance of the beam section. 8

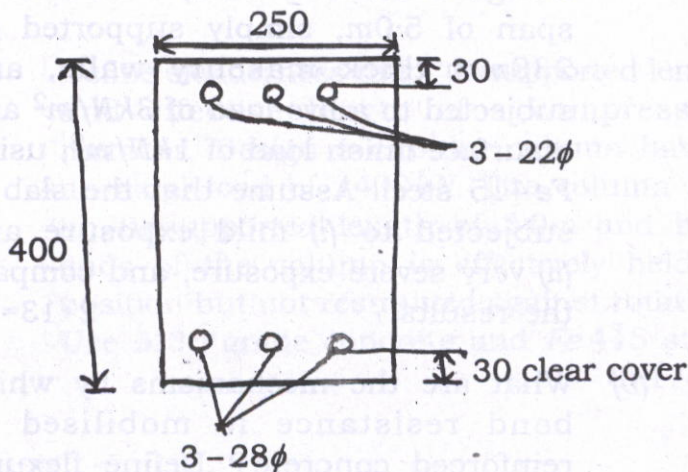

Figure 1

(c) A rectangular reinforced concrete beam, located inside a building in a coastal town, is simply supported on two 220mm thick and 6-m apart masonry walls (centre to centre). The beam has to carry, in addition to its own weight, a distributed live load of 10kN/m and a dead load of 5kn/m. Design the beam section for maximum moment at midspan. Assume $Fe\,415$ steel. 10

3. *(a)* What are the advantages and disadvantages of providing large clear cover to reinforcement inflexural members ?

Design a one-way slab, with a clear span of $5 \cdot 0 m$, simply supported on $230 mm$ thick masonry walls, and subjected to a live load of $3 kN/m^2$ and a surface finish load of $1 kN/m^2$, using Fe 415 steel. Assume that the slab is subjected to *(i)* mild exposure and *(ii)* very severe exposure, and compare the results. $2+13=15$

(b) What are the mechanisms by which bond resistance is mobilised in reinforced concrete ? Define flexural bond, development bond and development length. 5

4. Explain clearly the difference in the behaviour of one-way slabs and two-way slabs. A restrained concrete slab is of size $4 m \times 6 m$, having two short edges discontinuous. Design the slab if the live load is $4 kN/m^2$ and finished surface is $1 kN/m^2$. Use $M 25$ concrete and Fe 415 steel. $3+17=20$

5. Design an isolated footing for a column of size $300 \times 400mm$ carrying an axial load of $1200\,kN$. The safe bearing capacity of the soil is $150kN/m^2$. Use $M\,25$ concrete and $Fe\,415$ steel. 20

6. Define slenderness ratio, unsupported length and effective length of a compression member. Design a circular column having an axial load of $2400\,kN$. The column has an unsupported length of $3·0m$ and both ends of the column is effectively held in position but not restrained against rotation. Use $M\,30$ grade concrete and $Fe\,415$ steel.
$3+17=20$

_____