53 (CE 501) DGST

2017

DESIGN OF STRUCTURE-I

Paper : CE 501

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* Define balanced, under-reinforced and over-reinforced concrete sections with diagram. 3

   (b) Explain the concept of 'transformed section', as applied to the analysis of reinforced concrete beams under service load. 5

(c) A beam carries a uniformly distributed service load (including self-weight) of $40kN/m$ on a simply supported span of $7{\cdot}0m$. The cross-section of the beam are as follow -

size of the beam cross-section $350\times700mm$, reinforced by 4 nos. of 25ϕ, clear cover $30mm$. Assuming M 20 concrete and Fe 415 steel ; compute

(a) the stresses developed in concrete and steel at applied service loads.

(b) the allowable service load (in kN/m) that the beam can carry. 12

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

The cross-sectional dimensions of a T-beam are as follows : $\rightarrow$ width of flange = 1300, depth of flange = $100mm$, web thickness = $325mm$ and effective depth = $420mm$. The beam is reinforced by 7nos. 25ϕ. Determine the stresses in concrete and steel under a service load moment of $150\,kNm$ and also allowable moment capacity of the section at service loads. 20

3. *(a)* A beam section (rectangular), located inside a building in a coastal town, is simply supported on two 250*mm* thick and 6-*m* apart masonry walls (centre to centre). The beam has to carry in addition to its own weight, a udl 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

(b) A doubly reinforced section of 250 × 400*mm* effective depth is reinforced as follows :

$3-28\phi$ as tensile reinforcement and

$3-25\phi$ as compression reinforcement.

Assuming *M*20 concrete and *Fe* 415 steel, determine the ultimate moment of resistance of the beam section. 10

4. What do you mean by compression members ? Design a circular column having an axial load of 2000*kN*. The column has an unsupported length of 3·0*m* and both ends of the column is effectively held in position but not restrained against rotation. Use *M*25 concrete and *Fe* 415 steel. 20

5. Design an isolated footing for a column of size $300 \times 400mm$ carrying an axial load of $1200kN$. The safe bearing capacity of the soil is $150kN/m^2$. Use $M25$ concrete and $Fe\,415$ steel. 20

6. A restrained concrete slab is of size $3m \times 5m$ having 2 long edges discontinuous. Design the slab if the live load is $5kN/m^2$ and finish surface is $1kN/m^2$. Use $M20$ concrete and Fe 415 steel.

7. *(a)* Define development length. What is its significance ? What do you mean by flexural bond and development bond ? Enumerate the main factors that influence bond strength. 2+2+4=8

(b) A rectangular reinforced concrete beam of size $200 \times 400mm$ effective depth is subjected to a shear force of $200kN$ at working loads. The shear reinforcement at the section consists of 2-legged $8\,\phi$ stirrups @ $150mmc/c$. Calculate the tensile reinforcement requirement in the section for safety in shear. 12
