53 (CE 501) DGST-I

2018

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)* Why do we use less factor of safety for steel as compared to concrete? What do you understand by balanced section? What is the difference between under-reinforced and over-reinforced section? Why is it not preferred to design over-reinforced section? 7

(b) Define doubly reinforced section. A rectangular beam is 300*mm* wide and 450*mm* deep effective. The reinforcement consists of 4-25*mm* ϕ bars on tension side and 3-22ϕ on the compression side. Find the stresses set up in steel and concrete if the beam carries a total load of 20*kN/m* including self weight over a span of 8*m*. Take $d' = 40mm$. Also find the allowable and ultimate moment of resistance. 13

2. (a) Find the expressions of a neutral axis depth for *T*-beam. Give steps for determining the neutral axis depth of a over-reinforced beam section in limit state method. 5

(b) A rectangular reinforced concrete beam, located inside a building in a coastal town, is simply supported on two 230*mm* thick and 7*m* apart masonry walls centre to centre. The beam has to carry, in addition to its own weight, a distributed live load of 10*kN/m* and a dead load of 6*kN/m*, and also a concentrated dead load of 30*kN* placed at the midspan point. Design the flexural reinforcement for the beam, given that its size is limited to 250*mm* × 400*mm*. Assume *Fe* 415 steel. 12

(c) Explain the stress-strain relationship for concrete and steel with sketches used in limit state method of design. 3

3. (a) What are the various forms of shear reinforcement? What is the necessity of providing shear reinforcement? How can we increase the band between steel and concrete? What do you understand by the term development length? Write an expression to find the development length of bars in tension. 8

(b) A simply supported RCC beam 200*mm* × 400*mm* effective depth is reinforced with 4 bars of 20*mm* diameter on tension side. The beam is carrying a load of 10*kN/m* over a clear span of 8*m*. Design the shear reinforcement at support and midspan. Use *M*20 concrete and *Fe* 415 steel. 12

4. What is a two-way slab ? What are the types of two-way slab ? A restrained concrete slab is of size $4m \times 5m$ having two adjacent edges discontinuous. Design the slab if the live load is $7kN/m^2$ and a surface finish as $1kN/m^2$. Use $M25$ concrete and $Fe415$ steel. 20

5. Define isolated and combine footing. Design an isolated footing for a column of size $350 \times 500mm$ carrying an axial load of $1500kN$. The safe bearing capacity of the soil is $150kN/m^2$. Use $M25$ concrete and $Fe415$ steel. 20

6. Explain the difference between long column and short column. Design a circular column having an axial load of $2100kN$. The column has an unsupported length of $3{\cdot}0m$ and both ends of the column is effectively held in position but not restrained against rotation. Use $M30$ concrete and $Fe415$ steel. Also design the same column using helical reinforcement. 20