53 (CE 501) DGST

2017

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)* What do the terms stiffening setting and hardening mean, with reference to cement paste ? 2

(b) Determine the neutral axis depth in *T*–beam sections, when it lies *(i)* in the flange *(ii)* outside the flange. 3

(c) The cross-sectional dimensions of a *T*–beam are :

width of flange = 1200*mm*
thickness of flange = 100*mm*
thickness of web = 320*mm*
effective depth of beam section = 400*mm*.

Assuming M20 concrete and Fe 415 steel, compute —

(i) stresses in concrete and steel under a service load moment of 150*kNm*.

(ii) allowable moment capacity of the section at service loads.

12

(d) Explain the concept of transformed section, as applied to the analysis of reinforced concrete beam under service loads. 3

2. (a) Define doubly reinforced section with diagram. A doubly reinforced section of size 250×450*mm* is reinforced as 3–28ϕ as tensile reinforcement and 3–22ϕ as compressive reinforcement. Assuming M25 concrete and Fe 415 steel, determine the allowable and ultimate moment of resistance of the beam section. 2+10=12

(b) Explain in brief the 'Limit State Method' of Design. A beam section of size 300×550*mm* effective depth is reinforced with 4 nos. of 25*mm* diameter bars. Assuming M20 grade concrete and Fe 415 steel, determine the neutral axis depth (x_u), for the beam section. 3+5=8

3. *(a)* Define development length. What is its significance ? 3

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

(c) A simply supported beam of size 300×600*mm* effective depth of 6*m* span (*c/c*), is to carry a uniform dead load of 20*kN/m* including self weight and a uniform live load of 30*kN/m*. The width of the supporting wall is 230*mm*. The shear reinforcement at the section consists of 2–legged 10ϕ stirrups @150*mm c/c*. Assuming M25 concrete and Fe 415 steel, calculate the tensile reinforcement requirement in the section for safety in shear. 12

4. *(a)* Design the flexural reinforcement for the beam, given that its size in limited to 250*mm*×400*mm*. The beam has to carry, in addition to its own weight, a distributed live load of 10*kN/m*; a dead load of 5*kN/m* and a concentrated dead load of 30*kN* placed at midspan point. The beam is located inside a building in a coastal town, and is simply supported on two-220*mm* thick and 6*m* apart masonry walls (*c/c*). Design the beam section for maximum moment at midspan. Assume Fe 415 steel. 15

(b) Discuss the merits and demerits of working stress method and limit state method. 5

5. Define an isolated and combined footings with diagram. Design an isolated footing for a column of size $250 \times 350mm$ carrying an axial load of $1100kN$. The safe bearing capacity of the soil is $150kN/m^2$. Use M25 concrete and Fe 415 steel. Assume any missing datas. 3+17=20

6. Define one-way and two-way slabs with diagrams. A restrained concrete slab is of size $4m \times 6m$, having two long edges discontinuous. Design the slab of the live load is $5kN/m^2$ and finished surface is $1kN/m^2$. Use M25 concrete and Fe 415 steel. 4+16=20

7. What is meant by slenderness ratio of a compression member and what are its implications ? Define *(i)* unsupported length and effective length of a compression member *(ii)* braced and unbraced column.

   Design a circular column having an axial load of $1800kN$. 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 M25 concrete and Fe 415 steel. 5+15=20