Total number of printed pages–4

53 (CE 501) DGST–I

2021

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. Given percentages of tension steel (p_t) and compression steel (p_c) of a doubly-reinforced section, how is it possible to decide whether the beam is under-reinforced or over-reinforced at the ultimate limit state? A doubly-reinforced beam section of size 250 × 400 total depth is reinforced as 3-22ϕ as compression steel and 3-28ϕ as tensile steel. Assuming M 20 concrete and Fe 415 steel, determine ultimate moment of resistance. Assume clear cover = 30*mm*. 20

Contd.

2. The term balanced section is used in both Working Stress Method (WSM) and Limit State Method (LSM). Discuss the difference in meaning.

A rectangular reinforced concrete beam, its size limited to $250 \times 400mm$ is located in a coasted town is simply-supported on two $230mm$ thick masonry wall and 6 metre apart centre-centre. The beam has to carry in addition to its own weight, a distributed live load of $10kN/m$, a dead load of $5kN/m$ and a concentrated dead load of $30kN$ placed at the midspan point. Assuming the beam subjected to moderate exposure condition and Fe 415 steel, design the beam section. 20

3. *(a)* Explain clearly the difference between flexural bond and development bond. What is development length? What is its significance? 5

(b) Briefly describe the various bond failure mechanisms. 3

(c) Define shear reinforcement with figure. A reinforced concrete beam of size $250 \times 450mm$ effective depth is reinforced with 3-28ϕ as tensile reinforcement. The shear reinforcement consists of 2-legged 8ϕ stirrup @ $150mm$ c/c. Estimate the shear capacity of the section for M 25 concrete and Fe 415 steel. 12

4. Explain the need of corner reinforcement in two-way rectangular slabs whose corners are prevented from lifting up. Design a reinforced concrete slab for a room of clear dimensions of $3{\cdot}5m \times 4{\cdot}5m$, having one long edge discontinuous. The slab is supported on walls of thickness $320mm$. The slab is carrying a live load of $3kN/m^2$ and a floor finish of $0{\cdot}8kN/m^2$. use M 25 concrete and Fe 415 steel. 20

5. Design an isolated footing to support a column of size $300 \times 400mm$ to carry an axial load of $1500kN$. The safe bearing capacity of soil is $130kN/m^2$. The width of the footing is limited to $3m$. Assume M 25 concrete and Fe 415 steel. 20

6. *(a)* Distinguish between unsupported length and effective length of a compression member. What is meant by slenderness ratio of a compression member? 5

(b) Design a circular column having an axial load of $2000kN$. The unsupported length of the column is $3{\cdot}1m$. Use M 20 concrete and Fe 415 steel. Consider both ends of the column as effectively held in position but not restrained against rotation. 15