

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI
SECOND SEMESTER 2022 – 2023
EARTHQUAKE RESISTANT DESIGN & CONSTRUCTION

Course No: CE F428
Duration: 180 Mins

Date: 11-05-2023
Max. Marks: 70

Note: IS 1893:2016, IS 13920:2016, IS 456:2000 and SP 16 are allowed

1. Determine the seismic force as per modal analysis for a three storey building (SMRF) situated in Zone V. Consider the importance factor as 1 and the ground to be soft soil.

Mass of roof is 392 kN

Mass of second floor is 784 kN

Mass of first floor is 1568 kN

The natural period and mode shapes are given in the table.

[12 Marks]

	Mode 1	Mode2	Mode 3
Natural Period (s)	0.833	0.404	0.302
Roof	1	1	1
2 nd floor	0.791	0	-0.791
1 st Floor	0.25	-1	0.25

2. A shear wall is to be designed having a length of 4 m and thickness of 0.25 m. The height of the shear wall is 9 m. Consider the factored BM and factored shear force to be 8519 kN-m and 930 kN respectively. The factored axial load is 4152 kN. Design the shear wall as per IS 13920. Consider the grade of concrete to be M-25 and grade of steel to be Fe-415.

[15 Marks]

3. A beam AB (span=6 m) is to be designed as per ductility provisions of IS 13920. The design moments at end A and B are listed below. You are required to design the longitudinal reinforcements only.

$M_A = -69$ kN-m and 23 kN-m

$M_B = -88$ kN-m and 3 kN-m

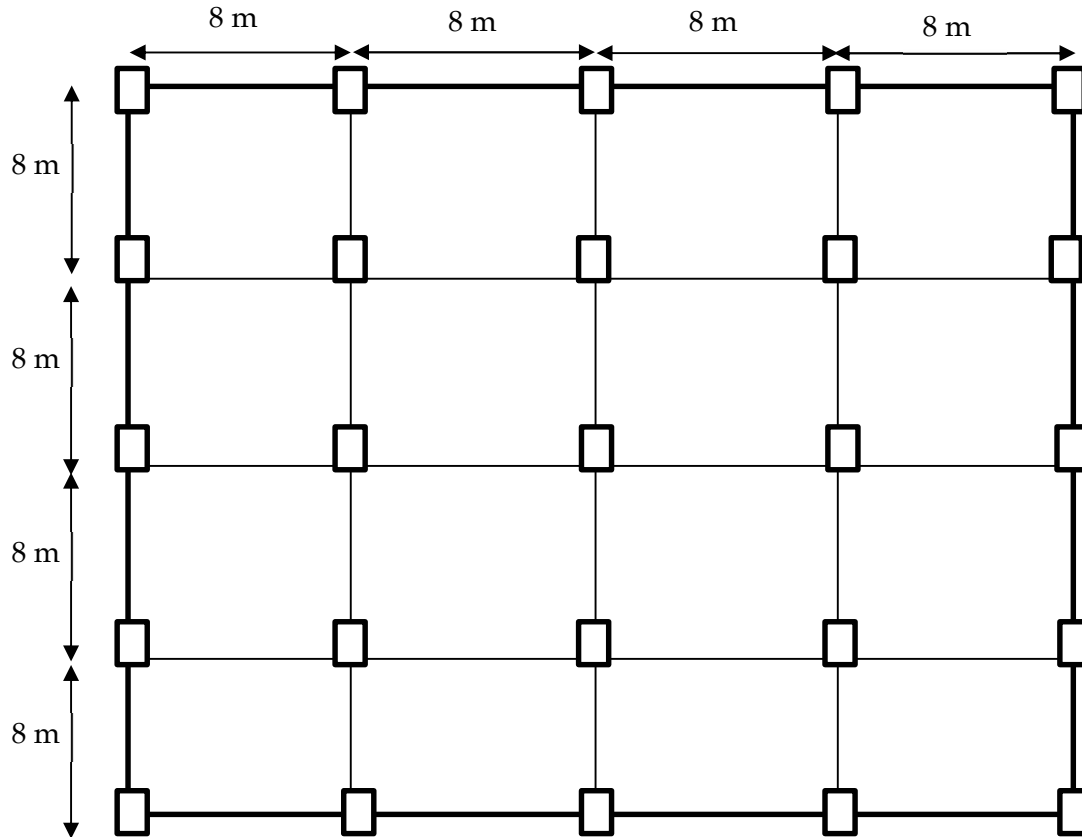
Consider the dimensions of the beam as 300 mm x 500 mm with 150 mm slab. Assume the grade of concrete as M-25 and grade of steel as Fe-415. Seismic zone to be considered in zone IV. Give the most optimized reinforcement configuration. Sketch the cross-sectional reinforcement details at ends A and B.

[13 Marks]

4. Design the reinforcement for a rectangular column having a size of 500 mm x 500 mm for a factored load of 3500 kN and factored bending moment of 315 kN-m. Consider the grade of concrete as M-25 and grade of steel as Fe-415. Clear span is 3500 mm.

[10 Marks]

5. A 15 storey building has the following plan dimensions. The height between the floors is 3 m. Evaluate the seismic forces and shears at various floor levels. Consider the dead load per unit area, comprising of floor slab, finishes, etc as 3.5 kN/m^2 and the intensity of live loads on each floor and roof as 3 kN/m^2 and 1.5 kN/m^2 respectively. The seismic zone is V and the foundation soil is hard. Neglect the presence of walls in your calculation. Beams and columns have dimensions of $550 \text{ mm} \times 300 \text{ mm}$. In case a shear wall is to be designed for this building, what will be the design bending moment? **[10 Marks]**



6. What are the advantages of modal superposition method over equivalent static lateral force method? **[2 Marks]**

7. Discuss about the influence of vertical irregularity on the seismic performance of buildings? **[3 Marks]**

8. Irregularities of mass, stiffness, and strength are not desirable in buildings situated in earthquake-prone areas. Describe using diagrams how these occur and affect the building. **[5 Marks]**