GUJARAT TECHNOLOGICAL UNIVERSITY

BE 6 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Design of Reinforced Concrete structures - 3160612

Chapter 1: Building Layout and Design

Repeated Questions:

1. Structural Layout of Buildings:

- **Q.** Prepare structural layout and nominate all the members like slabs, beams, columns of G+3 building (whole structure) of having 4 bays of 5m in X-direction and 4 bays of 3m in Y- direction. **(SUMMER 2022, 7 Marks; WINTER 2022 - 5 bays of 5m in X-direction and 3 bays of 3m in Y-direction; SUMMER 2023 - 5 bays of 5m in X-direction and 4 bays of 4m in Y-direction; SUMMER 2024, 4 Marks; WINTER 2024, 7 Marks; SUMMER 2025 - 4 bays of 4m in X-direction and 3 bays of 3m in Y-direction; WINTER 2025 - 4 bays of 5m in X-direction and 4 bays of 4m in Y-direction; SUMMER 2026 - 3 bays of 4m in X-direction and 4 bays of 4m in Y-direction)**
- **Q.** Write guidelines for preparation of structural layout for building. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks; WINTER 2023, 3 Marks)**

2. Wind Load on Multistoried Building:

- **Q.** A multistoried unbraced building as shown in Fig. 1 having 20m X 30m plan dimension and overall height of 30m is to be designed in [Location] in developed outskirt area with scattered buildings of its height. Determine the designed wind pressure acting on the internal frame of building and draw the pressure diagram. Assume bay width 5m each, Ground storey height 5m, Roof parapet 1m high and remaining storey height 4m each. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks; SUMMER 2026, 7 Marks)**

3. Continuous Beam – Load Calculation and Design:

- **Q.** For Q.2 (a) Calculate the load on any continuous beam of typical floor. Consider slab thickness is 120mm. Internal and external wall thickness is 230mm. Floor height is 3.0m. **(SUMMER 2023, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** For Q.2 (b) design the continuous beam and give the reinforcement detail of longitudinal section. **(SUMMER 2023, 7 Marks; WINTER 2025, 7 Marks)**

4. Structural Plan Density and Load Transfer:

- **Q.** Write a short note on (a) Structural Plan density (b) Plan aspect ratio of buildings. / Explain the structural plan density and aspect ratio for G+3 RC Framed residential building. **(SUMMER 2024, 7 Marks; WINTER 2024, 4 Marks; SUMMER 2025, 7 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Explain the mechanism of load transfer in multistoried (G+3 Story) buildings. / Explain the load path from super structure to sub structure with neat sketch. Also describe occurrence of various possible load on G+3 RC buildings. **(SUMMER 2024, 4 Marks; WINTER 2024, 7 Marks; SUMMER 2026, 7 Marks OR)**

Other Important Questions:

1. Wind Load Estimation (Numerical):

- **Q.** A G+6 storey commercial building of 29m height is having 4 bays of 4m in both x & y directions. The floor height is 4m. Parapet height is 1m. The building is located at Surat. The upwind slope is less than 3°. Estimate the Wind loads at nodal points of internal frame. Assume depth of foundation is 3m and depth of beam is 500mm. Top of the ground beam is at ground level and depth of ground beam is 500mm. **(WINTER 2022, 7 Marks)**

- **Q.** A G+7 multistoried unbraced frame building of 30 m height is having a plan dimension 20m X 30m having bay width 5m in both direction. Take Ground floor height as 5m and all other floor height is 4m. Take parapet height 1m. The location of building is in "Vadodara" city of Gujarat state with the terrain category III. The upwind slope is less than 3°. Take plinth is at 1m above G.L. having no plinth beams but consider beams at 1m below G.L. and footings are provided at 2m below G.L. Assume overall depth of all beams = 500mm and slab thickness 150mm. Consider Design life of building as 100 years. Compute wind loads acting on an internal frame at node points and plot wind pressure diagram as per provisions of IS: 875(Part- III). **(SUMMER 2022, 7 Marks)**
- **Q.** A G+7 residential building of 24m height is having a plan dimension 20m x 20m, having bay width 4m in both directions. The floor height is 3.2m. Parapet height is 1m. The building is located at Surat. The upwind slope is less than 3°. Estimate the Wind loads acting on internal frame at nodal points. Assume the depth of foundation is 1.5m, depth of beam is 500mm and ground beam is located at 500mm below ground level. **(WINTER 2023, 7 Marks)**
- **Q.** A G+6 multistoried braced frame building of 30m height is having a plan dimension 20m×30m, having bay width 5m in both directions. Take Ground floor height as 5m and all other floor height is 4m. Take parapet height 1m. The location of building is in Chennai city with the terrain category III. The upwind slope is less than 3°. Assume overall depth of all beams = 500mm and slab thickness 150mm. Consider Design life of building as 100 years. Compute wind loads acting on an internal frame at node points and plot wind pressure diagram as per provisions of IS: 875(Part-III). **(WINTER 2025, 7 Marks)**

2. Design of Beam, Slab and Column (Numerical):

- **Q.** Estimate the load on the Continuous beam of span 5m of above example Q.2 (b) and design it. **(SUMMER 2022, 7 Marks OR)**
- **Q.** Enlist different types of slab form in above layout Q.2 (a) and Design any one slab panel with reinforced details. / Enlist different types of slab form in above layout Q.2 (b) and Design any one slab panel with reinforced details. **(SUMMER 2022, 7 Marks OR; WINTER 2025, 7 Marks OR)**
- **Q.** Design the ground floor column for the G+3 building given in Q.2 (a) **(SUMMER 2023, 7 Marks OR)**

3. Structural Systems and Load Combinations (Theory):

- **Q.** Write a brief note on various types of structural system. **(WINTER 2024, 3 Marks)**
- **Q.** What are the different load combinations? Why are the multistoried buildings designed for various load combinations? **(WINTER 2024, 3 Marks OR)**

Chapter 2: Design of Retaining wall

Repeated Questions:

1. Types of Retaining Walls:

- **Q.** Explain different types of retaining wall / Enlist and explain various types of the retaining walls based on their usage / Discuss briefly various types of retaining walls with neat sketches and situations where a particular type is used. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks OR; SUMMER 2023, 3 Marks; WINTER 2023, 4 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 4 Marks; SUMMER 2026, 4 Marks)**

2. Cantilever Retaining Wall (Numerical):

- **Q.** The cantilever retaining wall has to retain the earth with a horizontal top [X] m above ground level. Density of earth is [X] kN/m³. Angle of internal friction ϕ is 30 degree. SBC of soil is [X] kN/m². Coefficient of friction μ is [X]. Determine dimensions of the retaining wall. Use [Grade]. **(SUMMER 2022, 7 Marks - 4 m, 17 kN/m³, 150 kN/m², 0.55, M20; SUMMER 2023, 7 Marks - 5.0 m, 18 kN/m³, 180 kN/m², 0.5, M30; WINTER 2023, 7 Marks - 3.4 m, 17 kN/m³, 170 kN/m², 0.56; WINTER 2025, 7 Marks - 5.5 m, 20 kN/m³, 120 kN/m², 0.5, M25)**
- **Q.** For problem [X] above, check the stability of wall. **(SUMMER 2022, 4 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** For problem [X] above, design [Component] and draw sketch of reinforcement details. **(SUMMER 2022, 7 Marks - Design Stem; SUMMER 2023, 7 Marks - Heel Slab, M25; WINTER 2023, 7 Marks OR - Design a stem; WINTER 2025, 7 Marks - Toe Slab, M25)**

3. Counterfort Retaining Wall (Numerical):

- **Q.** A counterfort retaining wall with height 6m, footing depth 1m, with 450mm thick base having width 4.5m is constructed to retain the earth of 6m. The top surface is horizontal behind the wall. The counterforts are provided at a 3m c/c. The soil behind the wall is a well drained medium dense soil (unit weight = 16.2 kN/m³, angle of internal friction, ϕ = 30°; Safe bearing capacity of soil 150kN/m²). The coefficient of friction between the base and soil is 0.6. Estimate the horizontal and vertical loads and moments. Wall is designed with grade M20 concrete and Fe 415 steel. **(SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 4 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** The Counterfort retaining wall has to retain the earth with a horizontal top [X] m above ground level. Density of earth is [X] kN/m³. Angle of internal friction ϕ is 30 degree. SBC of soil is [X] kN/m². Coefficient of friction μ is [X]. Determine dimensions of the retaining wall and check the stability of wall. Draw neat sketch. **(SUMMER 2022, 7 Marks OR - 6 m, 16.2 kN/m³, 150 kN/m², 0.6, M20; SUMMER 2023, 7 Marks - 6.0 m, 18 kN/m³, 180 kN/m², 0.6; WINTER 2023, 7 Marks OR - 6 m, 16.2 kN/m³, 150 kN/m², 0.6, M20; WINTER 2025, 7 Marks - 6.5 m, 20 kN/m³, 120 kN/m², 0.6)**

4. Retaining Wall – Complete Design Problem (Numerical):

- **Q.** A retaining wall is constructed to retain the earth 4m high. The top surface is horizontal behind the wall. The soil behind the wall is well drained medium dense sand with following properties: Unit Weight = 17 kN/m³, angle of internal friction, ϕ = 30°. The material under wall base is same as above with safe bearing capacity of 150kN/m². The coefficient of friction between the base and soil is 0.55. Use M20 grade and HYSD reinforcement of grade Fe 415. Determine the coefficient of earth pressure, base width. Determine the thickness of stem and base slab for the retaining wall mentioned. Determine the soil pressure distribution and check wall stability. **(SUMMER 2024, 7+4+7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 7+4+7 Marks OR; SUMMER 2026, 7 Marks)**

Other Important Questions:

1. Retaining Wall Problems (Numerical):

- **Q.** A retaining wall is constructed to retain the earth 4m high … [Data truncated in source – refer to the original question paper] **(SUMMER 2024, 7 Marks - continuation of the above retaining wall question, specifically asking only base width)**
- **Q.** Determine the thickness of stem and base slab for the retaining wall mentioned in Q 2(a). **(SUMMER 2024, 4 Marks)**
- **Q.** For the above problem stated in Q. 2(b), Determine the soil pressure distribution and check wall stability. **(SUMMER 2024, 7 Marks)**
- **Q.** A cantilever retaining wall has to retain level backfill of height 3.5m above ground level. Unit weight of soil = 18kN/m³, Angle of repose of soil = 28°, SBC of soil = 180kN/m² and coefficient of friction = 0.55. Fix basic dimensions of the cantilever retaining. **(WINTER 2022, 4 Marks)**
- **Q.** Using data of Q.2(b), determine factor of safety against overturning and sliding of the cantilever retaining wall. Also, determine minimum & maximum pressure at the base of the cantilever retaining wall. **(WINTER 2022, 7 Marks)**
- **Q.** A counterfort retaining wall has to retain level backfill of height 6m above the ground level. Unit weight of soil = 18kN/m³, Angle of repose of soil = 28° and SBC of soil = 180kN/m². Fix the basic dimensions of the various elements of counterfort retaining wall. **(WINTER 2022, 4 Marks OR)**
- **Q.** Using data of Q.3(b) OR, design the stem of counterfort retaining wall. **(WINTER 2022, 7 Marks OR)**

2. Retaining Wall Theory:

- **Q.** Explain different types of retaining wall. **(WINTER 2022, 3 Marks OR)**
- **Q.** Draw neat sketch of behaviour of various components of the cantilever retaining wall. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** How you will provide drainage to retaining wall? State the stability requirements for the retaining wall. **(SUMMER 2024, 7 Marks OR; SUMMER 2025, 4 Marks)**
- **Q.** Explain the criteria for stability of the structure against overturning and sliding as per IS 456-2000. **(WINTER 2025, 3 Marks)**

Chapter 3: Design of Water Tank

Repeated Questions:

1. Intze Tank, Joints and Reinforcement Criteria (Theory):

- **Q.** Draw the Intze tank and explain various structural elements of Intze tank. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks OR; WINTER 2023, 4 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks OR; SUMMER 2026, 3 Marks)**
- **Q.** Enlist the minimum reinforcement criteria for the structures retaining liquid in context to IS 3370. **(SUMMER 2023, 4 Marks; SUMMER 2024, 4 Marks OR; WINTER 2024, 4 Marks OR; SUMMER 2025, 4 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks OR)**
- **Q.** Explain Construction joints can be used in water tanks with sketches / Explain the Various types of joints can use in water tanks. with necessary sketches / Various types of Construction joints can be used in water tanks. Explain any two with neat with sketches. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks; SUMMER 2023, 4 Marks OR; SUMMER 2024, 3 Marks; WINTER 2024, 7 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Classify different jointing material used in the water tank. Explain any one in detail. **(WINTER 2023, 3 Marks OR; SUMMER 2025, 4 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Draw neat sketches of behaviour of cylindrical tank for the following cases: (i) wall with fixed base and free top, subjected to triangular load (ii) wall with hinged base and free top, subjected to triangular load. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks; WINTER 2024, 4 Marks)**

2. Circular Water Tank (Numerical):

- **Q.** The circular water tank of [X] kl capacity is required to construct below ground level. Considering flexible base, determine dimensions of the tank. The free board is [X] m. The unit weight of soil is [X] kN/m³ and angle of internal friction is 30°. Use [Grade]. **(SUMMER 2023, 4 Marks - 450 kl, 0.2 m, 17 kN/m³, M30; WINTER 2025, 7 Marks OR - 500 kl, 0.2 m, 20 kN/m³, M25)**
- **Q.** For Q. [X] above, design components of circular water tank and draw detailed plan and section of water tank showing all the dimensions and reinforcements. **(SUMMER 2023, 7 Marks; WINTER 2025, 7 Marks OR)**
- **Q.** A circular underground water tank of [X] m diameter and depth [X] m is hinged at base and free at top. Using IS 3370 (Part- 4), determine tension coefficients and moment coefficients for the design of tank wall. Use M30 grade of concrete and Fe415 steel. Take unit weight of dry soil [X] kN/m³ and $\phi = 30°$. **(WINTER 2022, 4 Marks - 10 m, 3 m, 18 kN/m³; WINTER 2023, 7 Marks - 12 m, 3.2 m, 17 kN/m³)**

3. Crack Control and Footing (Numerical):

- **Q.** A slab of water retaining structure is 300mm thick. Assuming that construction has movement joints placed at 13m c/c, and construction is being carried out in summer. Determine the maximum spacing of cracks and distribution of steel (or reinforcement for moisture and temperature) for the slab. The material is M30 grade concrete and grade of steel is Fe500. / A wall in a long reservoir is 90m long, 4m high and 350mm thick. Calculate the steel area to control thermal cracking and the joint spacing for (i) Continuous casting with no contraction joint and (ii) Semi-continuous for partial restraint as per design code for a design crack width of 0.2mm. Use M35 grade concrete and Fe 500D steel grade for construction. **(SUMMER 2024, 7 Marks OR; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks OR; SUMMER 2026, 7 Marks OR)**
- **Q.** An isolated rectangular sloped footing for the columns of size 230mm × 650mm reinforced with 6 bars of 20mm diameter and carrying an axial load of 1200kN. The bearing capacity of soil is 300kN/m². Take offset from face of the column equal to 50mm. Determine the dimensions of footing. **(SUMMER 2024, 4 Marks; WINTER 2024, 4 Marks)**

Other Important Questions:

1. Water Tank Wall Design (Numerical):

- **Q.** Design the cylindrical wall of the water tank for (i) the tank is full of water and no soil outside, (ii) the tank is empty and surrounding soil is dry. / Also, design the cylindrical wall of the water tank for the tank is full of water and no soil outside. **(WINTER 2022, 7 Marks; WINTER 2023, 7 Marks - continuation)**
- **Q.** A cantilever wall of water retaining structure is free at top and fixed at bottom is 4m high and is subjected to water pressure to full height. Determine minimum thickness required for flexure. The water tank is designed with M30 concrete and Fe 500 steel grade. **(SUMMER 2026, 7 Marks)**

2. Limit State Method and Cracks in Water Tanks (Theory):

- **Q.** Explain the limit state method as applied to water retaining structures. **(SUMMER 2024, 7 Marks OR; WINTER 2024, 3 Marks)**
- **Q.** What are the reasons of cracks in Water Tank? How are they overcome? **(SUMMER 2026, 3 Marks OR)**

3. Intze Tank Design (Numerical):

- **Q.** Fix the basic dimensions of Intze type container of an elevated water tank to store [X] lacs liter of water. Height of staging = 15m up to bottom of tank. Use M30 grade concrete and Fe 415 grade steel. **(SUMMER 2022, 3 Marks - 8 lacs, wind load = 1.5 kN/m²; WINTER 2022, 4 Marks OR - 5 lacs)**
- **Q.** Using data of Q.5(b) OR, design top spherical dome and top ring beam. / Design and detail top dome. / Design top ring beam and cylindrical wall. **(SUMMER 2022, 4 Marks; SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks OR)**

4. Rectangular Underground Tank (Numerical):

- **Q.** For rectangular underground water tank for a capacity of 70,000 litres, calculate Bending moments and direct compression on long wall and short wall. Consider tank is empty and surrounding soil is saturated. The saturated unit weight of soil is 18kN/m³ and angle of internal friction is 30°. Use M30 and Fe 415. **(SUMMER 2023, 4 Marks OR)**
- **Q.** For Q.4 (b) above, Design Long wall and Short Wall with all necessary checks and give details of reinforcement with sketches. **(SUMMER 2023, 7 Marks OR)**
- **Q.** Fix the basic dimension of rectangular underground tank of capacity 68,000 liters and find the design constants. Use M30 concrete and Fe415 grade steel. Take saturate unit weight of soil 18kN/m³ and $\phi = 30°$. **(SUMMER 2022, 7 Marks)**

5. Isolated Footing (Numerical):

- **Q.** For an isolated footing as mentioned above in Q. 4(b), Determine the depth of footing in two orthogonal directions. **(SUMMER 2024, 7 Marks)**
- **Q.** An RCC column of size 350mm × 350mm reinforced with 8 no. 16mm diameter bars carries a characteristic load of 800kN. The allowable bearing pressure on soil is 200kN/m². Calculate the trial size of footing and net upward pressure. The materials are grade M20 concrete and Fe 415 HYSD for both, the column and the footing. **(SUMMER 2025, 4 Marks OR)**
- **Q.** For the above Q.3(a) evaluate the steel requirement and development length. **(SUMMER 2025, 4 Marks OR)**
- **Q.** For the above parameters obtained in Q. 3(a-b), check the isolated square footing for shear and design the appropriate dimension of base. The reinforcement detailing in PLAN and section need to be present with neat sketches. **(SUMMER 2025, 4 Marks OR)**

Chapter 4: Design of Flat Slab

Repeated Questions:

1. Flat Slab – Theory and Codal Provisions:

- **Q.** Enlist advantages and disadvantages of flat slab. **(SUMMER 2022, 3 Marks; SUMMER 2023, 3 Marks; SUMMER 2024, 3 Marks OR; SUMMER 2025, 7 Marks)**
- **Q.** Explain the codal provision of Direct Design Method for Flat slab / Which are the conditions to be fulfilled for the design of flat slab by Direct Design Method? **(SUMMER 2022, 4 Marks; WINTER 2022, 3 Marks OR; SUMMER 2023, 4 Marks; SUMMER 2024, 4 Marks OR; WINTER 2024, 4 Marks; WINTER 2024, 7 Marks OR; SUMMER 2026, 3 Marks OR)**
- **Q.** Which are the assumptions made to analyze the flat slab by Equivalent Frame Method. **(WINTER 2022, 3 Marks OR; WINTER 2023, 7 Marks; SUMMER 2024, 3 Marks OR; WINTER 2024, 3 Marks OR; SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** What are the flat slab and conventional slab-beam diaphragms? Explain with suitable examples. / Differentiate the flat slab and conventional slab- beam diaphragms? Explain with suitable examples. **(SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks; SUMMER 2026, 4 Marks OR)**

2. Flat Slab Design (Numerical):

- **Q.** Determine depth of the flat slab and check flat slab interior panel of size [X] m × [X] m for the 'effects of pattern loading'. Columns are of size 400mm × 400mm. The storey height above and below slab is [X] m. Live load on panel is 3 kN/m². Floor finish load is 1 kN/m². **(WINTER 2022, 7 Marks OR - 5 m × 5 m, 3 m; WINTER 2023, 7 Marks - 6 m × 6 m, 3.2 m)**
- **Q.** Using data of Q.X OR, design flat slab interior panel. Also, check flat slab for shear. **(WINTER 2022, 7 Marks OR; WINTER 2023, 7 Marks)**
- **Q.** Design an interior panel of flat slab having equal panels of [X] m × [X] m. The internal columns are 500 mm in diameter and column head is 1000 mm in diameter. The story height above and below slab is 4m. Design the flat slab with drop and column head. Live load 4 kN/m². Use [Grade]. **(SUMMER 2022, 3 Marks - 5 m × 5 m, M20; WINTER 2025, 7 Marks - 4 m × 4 m, M25)**

Other Important Questions:

1. Flat Slab – Numerical and Theory:

- **Q.** Determine the main reinforcement for the interior panel of flat slab without drop and column head with following data: (i) Slab = 20m x 30m (ii) Panel size = 4m x 6m (iii) Live load = 4kN/m² (iv) Floor finishes = 1kN/m² (v) Size of column = 500mm x 500mm (vi) Floor to floor height = 4.0m. Use M20 and Fe 415. Draw neat sketch of reinforcement detailing. **(SUMMER 2023, 7 Marks)**
- **Q.** Explain the check for one way shear and two way shear for flat slab with code provisions. **(WINTER 2025, 4 Marks)**
- **Q.** Elaborate the limitations of direct design method used for flat slab. **(WINTER 2025, 3 Marks)**
- **Q.** Explain proportioning of Flat slab components as per IS: 456-2000. **(WINTER 2025, 3 Marks)**

Chapter 5: Earthquake Resistant Design of building

Repeated Questions:

1. Philosophy and Basic Concepts:

- **Q.** Explain Philosophy of Earthquake resistant design. List four virtue of good earthquake resistant design. / Explain philosophy of the earthquake resistant design of the structures. / Explain four virtues of Earthquake Resistant Design. / What is the basic design philosophy of seismic design of structures. **(SUMMER 2022, 7 Marks; WINTER 2022, 3 Marks; WINTER 2023, 4 Marks OR; WINTER 2023, 4 Marks OR; SUMMER 2024, 3 Marks; WINTER 2024, 3 Marks; WINTER 2025, 7 Marks OR)**
- **Q.** Define Following terms: (1) Epicenter (2) Focus (3) Critical Damping. **(SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks OR)**

2. Ductile Detailing:

- **Q.** Explain ductile detailing criteria for spacing of links over the entire length of the beam / Mention the ductile detailing criteria for flexural members as per IS 13920. / Explain Ductile detailing of beam as per IS 13920 (2016) with neat sketches. / Draw and detail the typical qualitative reinforcement detailing of two span reinforced concrete continuous rectangular beam of 230mm×450mm as per IS 13920-2016. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2022, 3 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 4 Marks OR; SUMMER 2026, 7 Marks OR)**
- **Q.** Explain ductile detailing of column as per IS: 13920-2016. / Explain ductile detailing criteria for spacing of links over the entire length of the column. **(SUMMER 2022, 3 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2023, 4 Marks; WINTER 2024, 7 Marks OR; WINTER 2025, 7 Marks)**

3. Irregularities, Column–Beam Concepts and Short Column:

- **Q.** Explain effect of Irregularities on performance of RC buildings during earthquakes / Explain different types of vertical irregularities in the buildings / Explain different types of mass and vertical irregularities in the buildings. **(WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks; WINTER 2023, 3 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks OR; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain with sketch (i) Short column effect (ii) Strong column weak beam / Explain the 'Strong column-Weak beam' design concept. / Explain Capacity Design Concept, [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks OR; SUMMER 2023, 4 Marks; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks OR)**

4. Seismic Analysis (Numerical):

- **Q.** Calculate base shear using seismic coefficient method for [X] storey [Building type] located at [Location]. Provide relevant data. **(SUMMER 2022, 7 Marks OR - 5 storey office, Bhuj; WINTER 2022, 7 Marks - 4 storey, 25 × 25, zone III; SUMMER 2023, 7 Marks OR - 4 storey hospital, Ahmedabad; WINTER 2023, 10 Marks - 4 storey, 20 × 25, zone IV; SUMMER 2026, 7 Marks - 3 storey community hall, zone V)**
- **Q.** Determine the fundamental natural period of four storied MRF building 13.5m × 13.5m in plan and height of 16.25m, if (i) It is considered without masonry infill; (ii) It is considered with masonry infill. **(SUMMER 2024, 7 Marks OR; WINTER 2024, 3 Marks OR; SUMMER 2025, 7 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Earthquake Resistant Design – Theory:

- **Q.** Explain about torsionally coupled and torsionally uncoupled system. **(WINTER 2022, 4 Marks; WINTER 2023, 4 Marks)**

- **Q.** Give the guidelines for efficient earthquake resistant design of structures. **(SUMMER 2023, 7 Marks OR; SUMMER 2024, 4 Marks OR)**
- **Q.** Discuss the expected damages by Earthquake in structures having (i) Soft storey (ii) Floating columns. **(SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Explain requirements of shear wall as per IS: 13920-2016. **(WINTER 2025, 7 Marks)**
- **Q.** Classify the methods of improving ductility in a structure. **(WINTER 2025, 7 Marks)**

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