GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–VI EXAMINATION – WINTER 2025

Subject Code: 3160612   **Date:29-11-2025**

Subject Name: Design of Reinforced Concrete structures

Time: 02:30 PM TO 05:00 PM   **Total Marks: 70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **IS: 456 (2000), IS-1893-1(2016), IS-13920(2016), IS-3370 (Part 1 to 4), SP-16, SP-34, IS-875 (Part 1 to 5) is permitted.**
6. **Use M20 grade of concrete and Fe415 grade of steel, until otherwise stated.**

			MARKS
Q.1*	**(a)**	Explain effect of Irregularities on performance of RC buildings during earthquakes.	**03**
	(b)	Explain various Joints used in water tank with sketch.	**04**
	(C)	A G+6 multistoried braced frame building of 30 m height is having a plan dimension 20 m X 30 m, having bay width 5 m in both directions. Take Ground floor height as 5 m and all other floor height is 4 m. 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 = 500 mm and slab thickness 150 mm. 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)	**07**
Q.2	**(a)**	Prepare structural layout and nominate all the members like slabs, beams, columns of G+3 building (whole structure) of having 4 bays of 5 m in X -direction and 4 bays of 4 m in Y direction.	**03**
	(b)	For Q.2 (a) Calculate the load on any intermediate continuous beam of typical floor. Consider slab thickness is 120 mm. Internal and external wall thickness is 230 mm.	**04**
	(c)	For Q.2 (b) deign the continuous beam and give the reinforcement detail of longitudinal section.	**07**
		OR	
	(c)	Enlist different types of slab form in of above layout Q.2 (a) and Design any one slab panel with reinforcement details.	**07**
Q.3	**(a)**	The cantilever retaining wall has to retain the earth with a horizontal top 5.5 m above ground level. Density of earth is 20kN/m^3. Angle of internal friction ϕ is 30 degree. SBC of soil is 120kN/m. Coefficient of friction μ is 0.5. Determine dimensions of the retaining wall. Use M25 and Fe 415.	**03**
	(b)	For problem 3(a) above, check the stability of wall.	**04**
	(c)	For problem 3(a) above, design Toe Slab and draw sketch of reinforcement details. Use M25 and Fe 415.	**07**

Q.3 **(a)** Explain the criteria for stability of the structure against overturning and sliding as per IS 456-2000. **03**

(b) Explain the check for one way shear and two way shear for flat slab with codal provisions. **04**

(c) The Counterfort retaining wall has to retain the earth with a horizontal top 6.5 m above ground level. Density of earth is $20kN/m^3$. Angle of internal friction ϕ is 30 degree. SBC of soil is$120kN/m^2$. Coefficient of friction μ is 0.6. Determine dimensions of the retaining wall and check the stability of wall. Draw neat sketch. **07**

Q.4 **(a)** Elaborate the limitations of direct design method used for flat slab. **03**

(b) Explain proportioning of Flat slab components as per IS: 456-2000. **04**

(c) Design an interior panel of flat slab having equal panels of 4 m × 4 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/m^2. Use M-25 concrete and Fe-415 steel. **07**

OR

Q.4 **(a)** Enlist the minimum reinforcement criteria for the structures retaining liquid in context to IS 3370. **03**

(b) The circular water tank of 500 kl capacity is required to construct below ground level. Considering flexible base, determine dimensions of the tank. The free board is 0.2 m. The unit weight of soil is $20kN/m^3$ and angle of internal friction is 30^0. Use M25 and Fe 415. **04**

(c) For Q. 4(b) above, design components of circular water tank and draw detailed plan and section of water tank showing all the dimensions and reinforcements. **07**

Q.5 **(a)** Explain ductile detailing of Column as per IS: 13920-2016. **03**

(b) Explain requirements of shear wall as per IS: 13920-2016. **04**

(c) Classify the methods of improving ductility in a structure. **07**

OR

Q.5 **(a)** Explain Capacity Design Concept **03**

(b) Explain Philosophy of Earthquake resistant design. Give four virtue of good earthquake resistant design. **04**

(c) Draw and detail the typical Qualitative reinforcement detailing of two span reinforced concrete continuous rectangular beam od 230mm X 450 mm as per IS13920-2016. **07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2024

Subject Code:3160612 **Date:12-12-2024**
Subject Name:Design of Reinforced Concrete structures
Time:02:30 PM TO 05:00 PM **Total Marks:70**

Instructions:
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.
5. IS: 456 (2000), IS-1893-1(2016), IS-13920(2016), IS-3370(2021 latest Code Part 1 to 4), SP-16, SP-34, IS-875 (Part 1 to 5) is permitted.
6. Use M20 grade of concrete and Fe415 grade of steel, until otherwise stated.

			MARKS
Q.1	**(a)**	What is the basic design philosophy of seismic design of structures.	**03**
	(b)	Explain the codal provision of Direct Design Method for Flat slab.	**04**

	(c)	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 Vadodara 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. Life of building is 30 years.

07
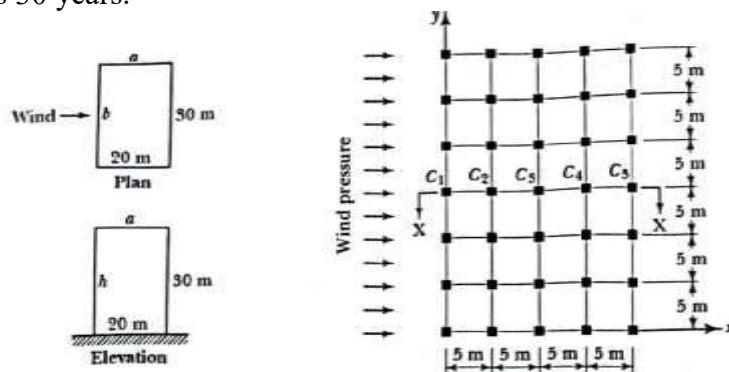
Fig. 1

Q.2	**(a)**	Explain concept of capacity design of structures.	**03**
	(b)	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.	**04**
	(c)	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/m^3, angle of internal friction, $\phi=30^0$. The material under wall base is same as above with safe bearing capacity of 150 kN/m^2. 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.	**07**

OR

	(c)	Explain different types of irregularities in the buildings for analyzing the building for possible occurrence of strong ground motion.	**07**

Q.3	**(a)**	Explain ductile detailing criteria for spacing of links over the entire length of the beam.	**03**
	(b)	Write a short note on (a) Structural Plan density (b) Plan aspect ratio of buildings.	**04**
	(c)	A counterfort retaining wall with height 6m, footing depth 1 m, 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/m^3, angle of internal friction, $\phi=30^0$; Safe bearing capacity of soil 150 kN/m^2). 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.	**07**

OR

Q.3	**(a)**	Which are the assumptions made to analyse the flat slab by the Equivalent Frame Method.	**03**
	(b)	Explain the codal provision of Direct Design Method for Flat slab.	**04**
	(c)	Explain the various types of retaining wall and their components with specific purpose and neat sketch.	**07**

Q.4	**(a)**	Write a brief note on various types of structural system.	**03**
	(b)	An isolated rectangular sloped footing for the columns of size 230mm X 650mm, reinforced with 6 bars of 20mm diameter and carrying an axial load of 1200kN. The bearing capacity of soil is 300 KN/m^2. Take offset from face of the column equal to 50mm. Determine the dimensions of footing.	**04**
	(c)	Explain the limit state method as applied to water retaining structures.	**07**

OR

Q.4	**(a)**	What are the different load combinations? Why are the multistoried buildings designed for various load combinations?	**03**
	(b)	Determine the fundamental natural period of four storied MRF building 13.5m X 13.5m in plan and height of 16.25m, if (i) It is considered without masonry infill; (ii) It is considered with masonry infill.	**04**
	(c)	Differentiate the flat slab and conventional slab-beam diaphragms? Explain with suitable examples.	**07**

Q.5	**(a)**	Various types of Construction joints can be used in water tanks. Explain any two with neat with sketches.	**03**
	(b)	Explain the mechanism of load transfer in multistoried (G+3 Story) buildings with suitable example.	**04**
	(c)	A slab of water retaining structure is 300 mm 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.	**07**

OR

Q.5	**(a)**	Prepare structural layout and designate all the members like beams, columns and slabs, of G+3 building (entire structure) of having 4 bays of 5 m in X – direction and 4 bays of 3 m in Y-direction.	**03**
	(b)	Enlist the minimum reinforcement criteria for the structures retaining liquid in context to IS 3370 (2021).	**04**
	(c)	Explain ductile detailing of column as per IS: 13920 with sketch.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2023

Subject Code:3160612   **Date:11-12-2023**
Subject Name:Design of Reinforced Concrete structures
Time:02:30 PM TO 05:00 PM   **Total Marks:70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **IS 456, IS 3370, IS 875, SP 16, IS 1893, IS 1343, IS 13920 are permitted.**
6. **Use M20 grade of concrete and Fe415 grade of steel, until otherwise stated.**

			MARKS
Q.1	**(a)**	Write guidelines for preparation of structural layout for building	**03**
	(b)	Explain ductile detailing criteria for spacing of links over the entire length of the beam.	**04**
	(c)	A cantilever retaining wall has to retain level backfill of height 3.4m above ground level. Unit weight of soil = 17kN/m^3 , Angle of repose of soil = 29º , SBC of soil = 170kN/m^2 and coefficient of friction = 0.56. Fix basic dimensions of the cantilever retaining.	**07**
Q.2	**(a)**	Enlist different types of vertical irregularities in the buildings and explain any one of them.	**03**
	(b)	Explain different types of retaining wall.	**04**
	(c)	Perform the stability checks of the cantilever retaining wall of Q. 1(c).	**07**
		OR	
	(c)	Design a stem of the cantilever retaining wall of Q.1 (c).	**07**
Q.3	**(a)**	Determine depth of the flat slab and check flat slab interior panel of size 6m × 6m for the 'effects of pattern loading'. Columns are of size 400mm × 400mm. The storey height above and below slab is 3.2m. Live load on panel is 3kN/m^2. Floor finish load is 1kN/m^2.	**07**
	(b)	Using data of Q.3(a), design flat slab interior panel. Also, check flat slab for shear.	**07**
		OR	
Q.3	**(a)**	Which are the conditions to be fulfilled for the design of flat slab by Direct Design Method?	**03**
	(b)	Explain ductile detailing criteria for spacing of links over the entire length of the column.	**04**
	(c)	State and explain the assumptions made to analyze the flat slab by Equivalent Frame Method.	**07**
Q.4	**(a)**	Explain about torsionally coupled and torsionally uncoupled system	**04**
	(b)	Calculate design base shear and storey shear using seismic coefficient method. A four storey building of 20m × 25m plan dimensions and 3m floor height is is located in seismic zone IV on a site with medium soil. The structure type is special moment resisting frame. Seismic weight are of first floor, second floor and third floor; W1 = W2 = W3 = 4200kN. Seismic weight of roof slab, W4 = 3400kN.	**10**

Q.4 **(a)** Explain philosophy of the earthquake resistant design of the structures. **04**

(b) A G+7 residential building of 24 m height is having a plan dimension 20 m x 20 m, having bay width 4 m in both directions. The floor height is 3.2 m. Parapet height is 1 m. 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 1.5 m, depth of beam is 500 mm and ground beam is located at 500 mm below ground level. **10**

Q.5 **(a)** Draw Intze tank and show various structural elements of the Intze tank. **04**

(b) A circular underground water tank of 12 m diameter and depth 3.2 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 $17kN/m^3$ and $\Phi=30°$. Also, design the cylindrical wall of the water tank for the tank is full of water and no soil outside. **10**

OR

Q.5 **(a)** Classify different jointing material used in the water tank. Explain any one in detail. **03**

(b) Explain four virtues of Earthquake Resistant Design. **04**

(c) Prepare structural layout for the RC frame G+3 storey commercial building having 4 bays of 4 m each in x-direction and 3 bays of 3 m each in y-direction. Floor height is 3.8m. Designate slabs, beams and columns. Suggest preliminary dimensions of the slab, beam and columns. **07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI(NEW) EXAMINATION – WINTER 2022
Subject Code:3160612   **Date:16-12-2022**
Subject Name:Design of Reinforced Concrete structures
Time:02:30 PM TO 05:00 PM   **Total Marks:70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **IS:456(2000), IS-1893-1(2016), IS-13920(2016), IS-3370 (Part 1 to 4), SP-16, SP-34, IS-875 (Part 1 to 5) are permitted.**
6. **Use M20 grade of concrete and Fe415 grade of steel, if not given.**

Q.1	**(a)**	Draw neat sketch of behaviour of various components of the cantilever retaining wall.	**03**
	(b)	Write guidelines for preparation of structural layout for building.	**04**
	(c)	A G+6 storey commercial building of 29 m height is having 4 bays of 4m in both x & y directions. The floor height is 4 m. Parapet height is 1 m. The building is located at Surat. The upwind slope is less than 3º. Estimate the Wind loads at nodal points of internal frame. Assume depth of foundation is 3 m and depth of beam is 500 mm. Top of the ground beam is at ground level and depth of ground beam is 500 mm.	**07**
Q.2	**(a)**	Explain ductile detailing criteria for spacing of links over the entire length of the beam.	**03**
	(b)	A cantilever retaining wall has to retain level backfill of height 3.5m above ground level. Unit weight of soil = 18kN/m^3, Angle of repose of soil = 28º, SBC of soil = 180kN/m^2 and coefficient of friction = 0.55. Fix basic dimensions of the cantilever retaining.	**04**
	(c)	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.	**07**
		OR	
	(c)	Explain different types of vertical irregularities in the buildings.	**07**
Q.3	**(a)**	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.	**03**
	(b)	Prepare structural layout for the RC frame G+3 storey commercial building having 5 bays of 5 m each in x-direction and 3 bays of 3 m each in y-direction. Floor height is 3.5m. Designate slabs, beams and columns. Suggest preliminary dimensions of the slab, beam and columns.	**04**
	(c)	Using data of Q.3(b), estimate load on intermediate continuous beam laying in y-direction. Assume wall thickness = 230mm.	**07**
		OR	
Q.3	**(a)**	Explain different types of retaining wall.	**03**
	(b)	A counterfort retaining wall has to retain level backfill of height 6m above the ground level. Unit weight of soil = 18kN/m^3, Angle of repose of soil = 28º and SBC of soil = 180kN/m^2. Fix the basic dimensions of the various elements of counterfort retaining wall.	**04**
	(c)	Using data of Q.3(b) OR, design the stem of counterfort retaining wall.	**07**

Q.4 **(a)** Draw Intze tank and show various structural elements of the Intze tank. **03**

(b) A circular underground water tank of 10 m diameter and depth 3 m is hinged **04** 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 18kN/m^3 and $\Phi=30°$.

(c) Using data of Q.4(b), design the cylindrical wall of the water tank for (i) the **07** tank is full of water and no soil outside, (ii) the tank is empty and surrounding soil is dry.

OR

Q.4 **(a)** Which are the assumptions made to analyse the flat slab by Equivalent Frame **03** Method.

(b) Determine depth of the flat slab and check flat slab interior panel of size 5m **04** × 5m for the 'effects of pattern loading'. Columns are of size 400mm × 400mm. The storey height above and below slab is 3m. Live load on panel is 3kN/m^2. Floor finish load is 1kN/m^2.

(c) Using data of Q.4(b) OR, design flat slab interior panel. Also, check flat slab **07** for shear.

Q.5 **(a)** Explain philosophy of the earthquake resistant design of the structures. **03**

(b) Explain about torsionally coupled and torsionally uncoupled system. **04**

(c) A four storey building of 25m × 25m plan dimensions and 3m floor height is **07** is located in seismic zone III on a site with medium soil. The structure type is special moment resisting frame. Seismic weight of first floor, second floor and third floor; $W_1 = W_2 = W_3 = 5000kN$. Seismic weight of roof slab, $W_4 = 3500kN$. Calculate design base shear and storey shear using seismic coefficient method.

OR

Q.5 **(a)** Which are the conditions to be fulfilled for the design of flat slab by Direct **03** Design Method?

(b) Fix the basic dimensions of Intze type container of an elevated water tank to **04** store 5 lacs liter of water. Height of staging =15 m up to bottom of tank. Use M30 grade concrete and Fe 415 grade steel.

(c) Using data of Q.5(b) OR, design top spherical dome and top ring beam. **07**

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