# GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI EXAMINATION – SUMMER 2025

Subject Code: 3160612   **Date:04-06-2025**

Subject Name: Design of Reinforced Concrete structures

Time: 10:30 AM TO 01:00 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
7. Simple and non-programmable scientific calculators are allowed

		MARKS

Q.1 **(a)** **Define** Following terms: (1) Epicenter (2) Focus (3) Critical Damping. **03**

(b) **Prepare** structural layout and nominate all the members like slabs, beams, columns of G+3 building (whole structure) of having 4 bays of 4 m in X –direction and 3 bays of 3 m in Y-direction. **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 Bharuch 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. **07**
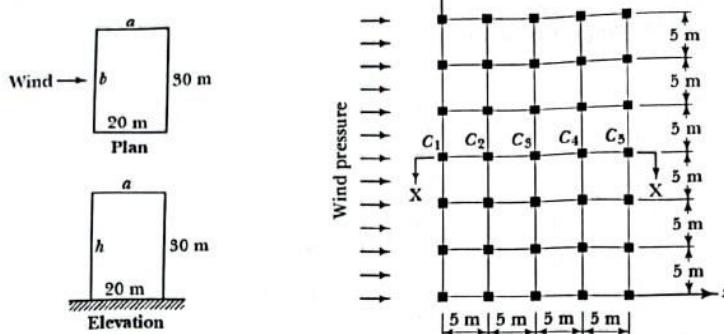
Fig. 1

Q.2 **(a)** 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. **03**

(b) How you will provide drainage to retaining wall? State the stability requirements for the retaining wall. **04**

(c) The plan and elevation of a three-storey RCC Community Hall is shown in **Fig. 2**. The building is located in seismic zone V. The type of soil encountered is medium stiff and it is proposed to design the **07**

building with a special moment resisting frame. The intensity of DL is 10 kN/m^2 and the floors are to cater to an IL of 3 kN/m^2. Determine the design seismic loads on the structure by static analysis.

(a) Plan   (b) Elevation
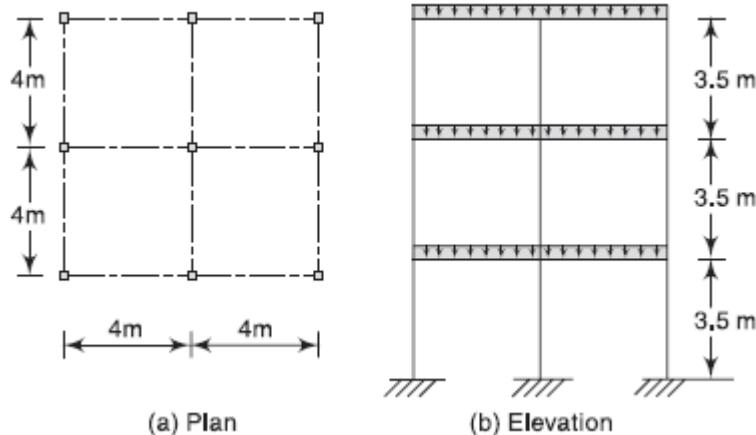
Fig. 2

OR

	(c)	**Explain** different types of mass and vertical irregularities in the buildings.	**07**
Q.3	**(a)**	**Discuss** the expected damages by Earthquake in structures having (i) Soft storey (ii) Floating columns	**03**
	(b)	**Explain** ductile detailing criteria for spacing of links over the entire length of the beam.	**04**
	(c)	**Enlist** advantages and disadvantages of flat slab. **Explain** the codal provision of Direct Design Method for Flat slab.	**07**

OR

Q.3	**(a)**	An RCC column of size 350 mm X 350mm reinforced with 8 no. 16mm diameter bars carries a characteristic load of 800 kN. The allowable bearing pressure on soil is 200kN/m^2. 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.	**03**
	(b)	For the above **Q.3(a)** evaluate the steel requirement and and development length.	**04**
	(c)	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.	**07**
Q.4	**(a)**	Which are the assumptions made to analyze the flat slab by Equivalent Frame Method.	**03**
	(b)	Classify different jointing material used in the water tank. Explain any one in detail.	**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 $= 16.2 \text{ kN/m}^3$, 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.4	**(a)**	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	**03**

= 17 kN/m^3, angle of internal friction, ϕ=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.

	(b)	Determine the thickness of stem and base slab for the retaining wall mentioned in **Q 4(a).**	**04**
	(c)	For the above problem stated in **Q. 4(b),** Determine the soil pressure distribution and check wall stability.	**07**
Q.5	**(a)**	**Discuss** briefly various types of retaining walls with neat sketches and situations where a particular type is used.	**03**
	(b)	**Write** an brief note on (a) Structural Plan density (b) Plan aspect ratio of buildings.	**04**
	(c)	**What** are the flat slab and conventional slab-beam diaphragms? Explain with suitable examples.	**07**

OR

Q.5	**(a)**	**Draw** the Intze tank and explain various structural elements of Intze tank.	**03**
	(b)	**Enlist** the minimum reinforcement criteria for the structures retaining liquid in context to IS 3370 (2021).	**04**
	(c)	A wall in a long reservoir is 90 m long, 4 m 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.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2024
Subject Code: 3160612   **Date:22-05-2024**
Subject Name: Design of Reinforced Concrete structures
Time: 10:30 AM TO 01:00 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)**	Explain Philosophy of Earthquake resistant design. List four virtue of good earthquake resistant design.	**03**
	(b)	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 3 m in Y-direction.	**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.	**07**
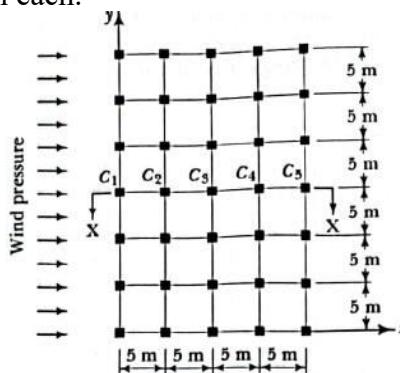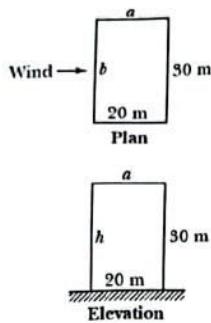
Fig. 1

Q.2	**(a)**	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.	**03**
	(b)	Determine the thickness of stem and base slab for the retaining wall mentioned in **Q 2(a).**	**04**
	(c)	For the above problem stated in **Q. 2(b),** Determine the soil pressure distribution and check wall stability.	**07**

<div align="center">OR</div>

	(c)	Explain different types of vertical irregularities in the buildings.	07
Q.3	(a)	Draw the Intze tank and explain various structural elements of Intze tank.	03
	(b)	Explain ductile detailing criteria for spacing of links over the entire length of the beam.	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)	Enlist advantages and disadvantages of flat slab.	03
	(b)	Explain the codal provision of Direct Design Method for Flat slab.	04
	(c)	Explain the limit state method as applied to water retaining structures.	07

Q.4	(a)	Explain Construction joints can be used in water tanks with sketches.	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)	For an isolated footing as mentioned above in **Q. 4(b),** Determine the depth of footing in two orthogonal directions.	07

OR

Q.4	(a)	Give the guidelines for efficient earthquake resistant design of structures.	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)	How you will provide drainage to retaining wall? State the stability requirements for the retaining wall.	07

Q.5	(a)	Write a short note on Mechanism of load transfer in multistoried (G+3 Story) buildings.	03
	(b)	Write an brief note on (a) Structural Plan density (b) Plan aspect ratio of buildings.	04
	(c)	What are the flat slab and conventional slab-beam diaphragms? Explain with suitable examples.	07

OR

Q.5	(a)	Which are the assumptions made to analyze the flat slab by Equivalent Frame Method.	03
	(b)	Enlist the minimum reinforcement criteria for the structures retaining liquid in context to IS 3370 (2021).	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

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

Subject Code:3160612   **Date:12-07-2023**

Subject Name:Design of Reinforced Concrete structures

Time:10:30 AM TO 01:00 PM   **Total Marks:70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Simple and non-programmable scientific calculators are allowed.

4. **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.**
5. **Use M20 grade of concrete and Fe415 grade of steel, until otherwise stated.**

			MARKS
Q.1	**(a)**	Enlist and explain various types of the retaining walls based on their usage.	**03**
	(b)	Enlist the minimum reinforcement criteria for the structures retaining liquid in context to IS 3370.	**04**
	(c)	The Counterfort retaining wall has to retain the earth with a horizontal top 6.0 m above ground level. Density of earth is 18kN/m³. Angle of internal friction ϕ is 30 degree. SBC of soil is180 kN/m². Coefficient of friction μ is 0.6. Determine dimensions of the retaining wall and check the stability of wall. Draw neat sketch.	**07**
Q.2	**(a)**	Prepare structural layout and nominate all the members like slabs, beams, columns of G+3 building (whole structure) of having 5 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 continuous beam of typical floor. Consider slab thickness is 120 mm. Internal and external wall thickness is 230 mm. Floor height is 3.0 m.	**04**
	(c)	For Q.2 (b) deign the continuous beam and give the reinforcement detail of longitudinal section.	**07**
		OR	
	(c)	Design the ground floor column for the G+3 building given in Q.2 (a)	**07**
Q.3	**(a)**	The cantilever retaining wall has to retain the earth with a horizontal top 5.0 m above ground level. Density of earth is 18kN/m³. Angle of internal friction ϕ is 30 degree. SBC of soil is 180kN/m. Coefficient of friction μ is 0.5. Determine dimensions of the retaining wall. Use M30 and Fe 415.	**03**
	(b)	For problem 3(a) above, check the stability of wall.	**04**
	(c)	For problem 3(a) above, design Heel Slab and draw sketch of reinforcement details. Use M25 and Fe 415.	**07**
		OR	
Q.3	**(a)**	Draw the Intze tank and explain various structural elements of Intze tank.	**03**

(b)	The circular water tank of 450 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 $17kN/m^3$ and angle of internal friction is 30^0. Use M30 and Fe 415.		**04**
(c)	For Q. 3(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.4	**(a)**	Enlist advantages and disadvantages of flat slab.	**03**
	(b)	Explain the codal provision of Direct Design Method for Flat slab.	**04**
	(c)	Determine the main reinforcement for the interior panel of flat slab without drop and column head with following data: (i) Slab = 20 m x 30 m (ii) Panel size = 4m x 6m (iii) Live load = $4kN/m^2$ (iv) Floor finishes = $1kN/m^2$ (v) Size of column = 500 mm x 500 mm (vi) Floor to floor height = 4.0 m. Use M20 and Fe 415. Draw neat sketch of reinforcement detailing.	**07**

OR

Q.4	**(a)**	Explain Construction joints can be used in water tanks with sketches.	**03**
	(b)	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 $18kN/m^3$ and angle of internal friction is 30°. Use M30 and Fe 415.	**04**
	(c)	For Q.4 (b) above, Design Long wall and Short Wall with all necessary checks and give details of reinforcement with sketches.	**07**

Q.5	**(a)**	Explain with sketch (i) Short column effect (ii) Strong column weak beam.	**03**
	(b)	Explain effect of Irregularities on performance of RC buildings during earthquakes.	**04**
	(c)	Draw and detail the typical qualitative reinforcement detailing of two span reinforced concrete continuous rectangular beam of dimension 230 mm X 550 mm as per IS 13920-2016.	**07**

OR

Q.5	**(a)**	Explain ductile detailing of column as per IS: 13920-2016.	**03**
	(b)	Give the guidelines for efficient earthquake resistant design of structures.	**04**
	(c)	Calculate base shear for the four storey special moment resisting RC frame hospital building located at Ahmedabad, having 4 nos. of bay in X-direction and 4 nos. of bay in Y-direction. Width of bay is 4 m. Height of each story is 3.5 m. Dead load on floors & roof including all (Slabs, Beams, Column, infill wall etc.) is $10kN/m^2$ and Live load is $4kN/m^{2.}$ Consider Medium soil. Use seismic coefficient method as per IS: 1893-2016. Also mention relevant clause as per IS: 1893-2016.	**07**

Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022

Subject Code:3160612   **Date:08/06/2022**
Subject Name:Design of Reinforced Concrete structures
Time:10:30 AM TO 01:00 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, if not given any where**

Q.1	**(a)**	Explain Philosophy of Earthquake resistant design. Give four virtue of good earthquake resistant design.	**03**
	(b)	Mention the ductile detailing criteria for flexural members as per IS 13920.	**04**
	(c)	A G+7 multistoried unbraced frame building of 30 m height is having a plan dimension 20m X 30m, having bay width 5 m in both direction. 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 "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 2 m below G.L. 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)**	State the guide lines for preparation of structural layout for building	**03**
	(b)	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 3 m in Y-direction.	**04**
	(c)	Enlist different types of slab form in of above layout Q.2 (b) and Design any one slab panel with reinforced details.	**07**
		OR	
	(c)	Estimate the load on the Continues beam of span 5 m of above example Q.2 (b) and design it.	**07**
Q.3	**(a)**	The cantilever retaining wall has to retain the earth with a horizontal top 4 m above ground level. Density of earth is 17 kN/m³. Angle of internal friction ϕ is 30˚. SBC of soil is 150 kN/m². Coefficient of friction μ is 0.55. Determine dimensions of the retaining wall. Use M20 grade of concrete and Fe 415 grade of steel.	**03**
	(b)	For problem 3 (a) above, check the stability of wall.	**04**
	(c)	For problem 3 (a) above, design Stem and draw diagram showing reinforcement details.	**07**
		OR	
Q.3	**(a)**	The counter fort retaining wall has to retain the earth with a horizontal top 6 m above ground level. Density of earth is 16.2 kN/m³. Angle of internal friction ϕ is 30˚. SBC of soil is 150 kN/m². Coefficient of friction μ is 0.6. Determine dimensions of the retaining wall. Use M20 grade of concrete and Fe 415 grade of steel.	**03**
	(b)	For problem 3 (a) above, check the stability of wall.	**04**
	(c)	For problem 3 (a) above, design stem and draw diagram showing reinforcement details.	**07**
Q.4	**(a)**	Explain the Various types of joints can use in water tanks. with necessary sketches	**03**
	(b)	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 18 kN/m³ and Φ = 30˚.	**04**

(c) Design long wall of water tank and furnish reinforcement Detailing for above Q.4(b) **07**

OR

Q.4 **(a)** Fix the basic dimensions of Intze type container of an elevated water tank to store 8 laces liter of water. Height of staging =15m up to bottom of tank, wind load = 1.5 KN/m2 throughout the height. Use M30 grade concrete and Fe 415 grade steel. **03**

(b) For Q-4 (a) above, Design and detail top dome. **04**

(c) For Q-4 (a) above, Design top ring beam and cylindrical wall. **07**

Q.5 **(a)** Describe advantages and disadvantages of Flat slab. **03**

(b) Explain the codal provision of Direct Design Method for flat slab. **04**

(c) Design an interior panel of flat slab having equal panels of 5m × 5m. The internal columns are 500 mm in diameter and column head is 1000 mm in diameter. The storey height above and below slab is 4m. Design the flat slab with drop and column head. Live load 4 kN/m^2. M-20 concrete and Fe-415 steel. **07**

OR

Q.5 **(a)** Explain ductile detailing of column as per IS: 13920 with sketch. **03**

(b) Explain the 'Strong column-Weak beam' design concept. **04**

(c) Calculate base shear for the five storey RC frame building (Office Building) has size 30 m X 30 m located in Bhuj, using seismic coefficient method for following data: Type of soil = Hard, the weight of the floors and height of the floors are 2000 kN, 2500 kN, 2500 kN, 2500 kN and 2100 kN respectively, and 4.5 m, 3.5 m, 3.5 m, 3.5 m, 3.5 m respectively from, slab no.1 from bottom. Also determine the seismic forces and shears at each floor level. **07**

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