GUJARAT TECHNOLOGICAL UNIVERSITY

BE 7 SEMESTER – OLD PAPER – SUMMER 2022 TO SUMMER 2026 – QUESTION BANK

Subject Name & Code: Design of Industrial Structures - 3170626

Chapter 1 – Industrial Building

Repeated Questions:

1. Bracings:

- **Q.** Describe the importance of Bracings in industrial structures. **(WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; SUMMER 2024, 4 Marks; SUMMER 2025)**

2. Roofing Systems:

- **Q.** Draw the various roofing system provided for industrial building. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks; WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks)**

3. Truss Members:

- **Q.** Why it is necessary to design truss member for both compression and shear forces. **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2023 OR)**

4. Loads and Load Combinations:

- **Q.** Write down / Give various loads and load combinations for design of steel structures as per codal provisions. **(SUMMER 2022; SUMMER 2023; SUMMER 2025 OR)**
- **Q.** Explain/Enlist various forces/loads to be considered in design of Gantry Girder. **(SUMMER 2022, 3 Marks; SUMMER 2026, 3 Marks OR)**

5. Purlin Design (Numerical):

- **Q.** Design an angle section for a continuous purlin having a segment span of 3m. It is subjected to UDL of [2/3/4] kN/m. Take angle of roof truss is [25/27]°. **(SUMMER 2024, 7 Marks OR; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks)**

6. Gantry Girder Design (Numerical):

- **Q.** Design a simply supported gantry girder to be used in an Industrial building for the following data: Crane Capacity = [120/140/150/160] kN, Weight of crab = [40/50] kN, Weight of crane (excluding crab) = [150/165/170] kN, Minimum clearance between crane hook and gantry girder = [1.2/1.5] m, Wheel base = [3/3.2] m, Distance between C/C of gantries = [20/22/25] m, Distance between C/C of gantry columns = [6/7] m, Crane type = M.O.T. **(SUMMER 2022, 4 Marks; WINTER 2022, 14 Marks; SUMMER 2023; WINTER 2024 OR; SUMMER 2025; SUMMER 2026, 4 Marks OR)**

7. Roof Truss Loads (Numerical):

- **Q.** Calculate Dead load, Live load & Wind load per panel point for a steel roof truss to be provided for factory at [Vadodara/Ahmedabad/Bhuj] with the help of following data: 1. Spacing and height of truss = 3.5m and 12m respectively. 2. Span and rise of truss = [12m and 2.5m] / [15m and 3m] respectively. 3. 10 Nos. of purlins including Ridge and eaves. 4. Length of shed = 30m. 5. Roof covering material = A.C. Sheet / Corrugated GI Sheets. 6. Probable life of Structure = 25 years. 7. Terrain data: Category- [II/III] and Class- [A/B]. 8. Topography of ground = Slope less than 3°. 9. Opening of Building = [10/25]% of wall area. **(SUMMER 2022, 14 Marks OR; WINTER 2022, 14 Marks OR; SUMMER 2023; SUMMER 2025; WINTER 2025 OR; SUMMER 2026, 3 Marks OR)**
- **Q.** An industrial building of size 15m × 44m is situated in Ahmedabad. It is on the ground having terrain category 3 and class A. Spacing between two trusses is 5m c/c. Rise of truss is 3.5m. Consider [12/20]% wall openings. The truss has total 10 segments. Roofing material is Corrugated GI Sheets with weight [120/150] N/m². Height of eaves above ground level is [15/18] m. Assuming

required suitable data (if necessary) carryout the following: Fix the configuration of the truss and Calculate Dead Load, Live Load & Wind Load per panel point. **(SUMMER 2023; SUMMER 2025)**

Other Important Questions:

1. Components of Industrial Building and Roof Truss:

- **Q.** List major components of Industrial Building. **(WINTER 2025, 3 Marks)**
- **Q.** Describe various parts of Roof Truss showing schematic diagram. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**
- **Q.** Prepare sketches for different types of roof trusses and briefly outline their suitability for different spans. [Diagram required – refer to the original question paper] **(SUMMER 2026, 3 Marks OR)**
- **Q.** Explain design steps for Purlin. **(WINTER 2025, 4 Marks)**

2. Purlin Design (Numerical):

- **Q.** Design an angle section purlin having 3.2m span. It is supported on five supports and carries load of 3kN/m. The angle of roof truss is 26°. **(WINTER 2025, 7 Marks OR)**

3. Roof Truss Configuration and Design (Numerical):

- **Q.** Fix the configuration of a roof truss for span 20m for an industrial building. **(WINTER 2024, 4 Marks)**
- **Q.** A roof truss for an industrial building with 15m span and 120m length is to be proposed. The roofing is galvanized iron sheeting and terrain is open industrial area and building is class A. The clear height of building at the eaves level is 9m. Assume appropriate data as per Indian Standard. Fix the configuration of the roof truss. **(SUMMER 2026, 3 Marks OR)**
- **Q.** Compute the member forces and design the members for the governing forces. Prepare a neat sketch of detailing. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**
- **Q.** An industrial building of size 15m × 44m is situated in Ahmedabad. It is on the ground having terrain category 3 and class A. Spacing between two trusses is 5m c/c. Rise of truss is 3.75m. Consider 10% wall openings. The truss has total 10 segments. Roofing material is Corrugated GI Sheets with weight 120 N/m². Height of eaves above ground level is 18m. Assuming required suitable data (if necessary) carryout the following: (a) Fix the configuration of the truss and Calculate Dead Load, Live Load & Wind Load per panel point (b) Design members meeting at support. **(SUMMER 2024 OR)**

4. Gantry Girder Design (Numerical):

- **Q.** An electrically operated gantry girder has following technical data: Span of crane girder = 15m, Span of gantry girder = 6.5m, Crane capacity = 210kN, Self weight of crane girder = 150kN, Self weight of trolley = 40kN, Distance between crane hook and the gantry girder = 1.2m, Wheel base = 3m, Self weight of rail section = 300N/m. (a) Decide preliminary section and check adequacy of the same in bending (07) (b) Apply checks for shear and deflection (07). **(SUMMER 2024, 14 Marks)**
- **Q.** A simply supported gantry girder is to be designed for an Industrial building using following data: Crane Capacity = 160kN, Weight of crab = 40kN, Weight of crane (excluding crab) = 200kN, Minimum clearance between crane hook and gantry girder = 1.2m, Wheel base = 3m, Distance between C/C of gantries = 20m, Distance between centre to centre of gantry columns = 7m, Crane type = M.O.T. Carryout basic load calculation and decide maximum wheel load on Gantry Girder. **(WINTER 2025, 3 Marks OR)**
- **Q.** In the above example Select appropriate section based on Maximum S.F. and Maximum B.M. **(WINTER 2025, 4 Marks OR)**
- **Q.** For the above decided section provide checks for Bending Capacity, Shear Capacity, Buckling Resistance and Deflection. **(WINTER 2025, 7 Marks OR)**

- **Q.** A simply supported Gantry Girder is to be designed to support an electric operated overhead travelling crane considering following data: Crane capacity = 250kN, self-weight of crane girder excluding trolley = 200kN, self-weight of trolley = 50kN, Min. Hook approach (i.e. distance between crane hook and gantry girder) = 1.2m, wheel base (i.e. distance between wheels) = 3.2m, span of crane girder (i.e. c/c distance between gantry rails) = 16m, span of gantry girder = 8m, self-weight of rail section = 0.5kN/m, Minimum Spacing between cranes = 2m. Fix the preliminary dimensioning of a gantry section. **(SUMMER 2026, 4 Marks OR)**
- **Q.** Design the Gantry Girder for the data given in previous question [Q.5 (b) OR]. Checks for buckling and deflections are required. **(SUMMER 2026, 7 Marks OR)**

Chapter 2 – Transmission and Communication towers

Repeated Questions:

1. Uses of Steel Towers:

- **Q.** Enlist / Write down / Discuss structural uses / applications of steel towers. **(WINTER 2022, 4 Marks OR; SUMMER 2023, 4 Marks; SUMMER 2024, 3 Marks; WINTER 2024 OR; SUMMER 2025; WINTER 2025, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

2. Loads on Transmission Line Towers:

- **Q.** Explain various types of loads acting on the transmission line towers. Under what circumstances torsional load occur on them? **(SUMMER 2023 OR; WINTER 2024 OR; SUMMER 2025; SUMMER 2026)**

3. Transmission Line Tower:

- **Q.** Explain in details about transmission line tower with neat Sketches. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks OR; WINTER 2024, 4 Marks; SUMMER 2026, 3 Marks)**

4. Types of Towers:

- **Q.** Give / Explain different types of transmission / communication tower as per structural action. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks; SUMMER 2023, 4 Marks; SUMMER 2025)**

Other Important Questions:

1. Tower Height:

- **Q.** Explain in brief the factors governing the height of transmission line tower. **(WINTER 2025, 4 Marks)**
- **Q.** How the total height of a transmission line tower is calculated? Explain in brief the factors governing the height of transmission line tower. **(SUMMER 2025 OR)**

2. Loads and Load Combinations on Towers:

- **Q.** Describe loads & load combinations to be considered while doing Analysis and design of tower & their foundations. **(WINTER 2025, 7 Marks)**
- **Q.** Write a brief note on loads acting on Transmission Line Towers. **(SUMMER 2024, 7 Marks)**
- **Q.** Explain various loads acting on Transmission Line Towers. **(WINTER 2022, 7 Marks)**

Chapter 3 – Chimneys

Repeated Questions:

1. Height of Chimney:

- **Q.** Explain briefly the factor influencing the height of chimney. **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks)**

2. Foundation of Chimney:

- **Q.** Write down the design procedure adopted for the foundation of chimney. **(SUMMER 2022, 7 Marks OR; WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks; WINTER 2025, 7 Marks)**

3. Classification of Chimneys:

- **Q.** Give the classification of industrial chimneys. **(WINTER 2022, 4 Marks; WINTER 2024, 4 Marks; SUMMER 2026, 3 Marks)**

4. Design Procedure of Chimney:

- **Q.** Briefly explain the procedure adopted in the design of chimneys and draw typical cross section showing details of reinforcements (Vertical and horizontal). [Diagram required – refer to the original question paper] **(SUMMER 2025; SUMMER 2026)**

5. Stresses at Base of RC Chimney (Numerical):

- **Q.** A reinforced concrete chimney 50m high above ground has an outside diameter of 4m. The thickness of the shell is 250mm / 280mm throughout. Vertical steel is taken as 1% of the cross sectional area throughout. The total wind load above the base may be taken as 100 kN / 200 kN. Find the stresses developed due to wind and dead load at the base of chimney. Assume modular ratio = 13. **(WINTER 2022 OR; WINTER 2025, 7 Marks)**
- **Q.** A reinforced concrete chimney 90m high above ground has an outside diameter of 5.5m. The thickness of the shell is 25cm throughout. Vertical steel is taken as 1.15% of the cross sectional area throughout. The total wind load above the base may be taken as 300kN. Find the stresses developed due to wind and dead load at the base of chimney. Use M25 concrete and Fe500 steel. **(SUMMER 2022, 10 Marks; SUMMER 2023)**

Other Important Questions:

1. RCC Chimney (Theory):

- **Q.** Explain various force components acting on RCC chimney. **(WINTER 2025, 3 Marks)**
- **Q.** Explain various steps for design of RCC chimney. **(WINTER 2025, 4 Marks)**

2. Stresses at Base of RC Chimney (Numerical):

- **Q.** A reinforced concrete chimney 95m high above ground has an outside diameter of 6m. The thickness of the shell is 25cm throughout. Vertical steel is taken as 1.15% of the cross sectional area throughout. The total wind load above the base may be taken as 350kN. Find the stresses developed due to wind and dead load at the base of chimney. Use M25 concrete and Fe500 steel. **(WINTER 2024 OR)**

3. Design of RC Chimney (Numerical):

- **Q.** Calculate the load and eccentricity at base section of a R.C. chimney of height 60m. Given: External Diameter of Chimney at top = 4.0m, Internal Diameter of Chimney at base = 4.8m, Shell thickness at top = 200mm, Shell thickness at base = 400mm, wind intensity = 1.8kN/m² (uniform throughout), Thickness of fire brick lining = 100mm, Air gap = 100mm, Temperature difference = 80°C, Coefficient of thermal expansion = 11×10^{-6}/°C. Take unit weight of brick lining = 20kN/m³ and Modulus of elasticity of steel, Es = 210×10^3 N/mm². Use M25 grade concrete and Fe415 steel. **(SUMMER 2026)**

- **Q.** Design a R.C. chimney and check the stresses in bars for the data given in previous question [Q.4 (a)]. Show reinforcement detailing at base section of a chimney with a neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2026)**
- **Q.** Design a chimney for height of 90m and check the stresses at base in bars. Data given: a) External diameter at top = 3.8m b) External diameter at base = 5.0m c) Shell thickness at top = 200mm d) Shell thickness at base = 400mm e) Wind Intensity = 2kN/m² throughout f) Thickness of fire brick lining = 100mm g) Temperature difference = 75°C h) Coefficient of thermal expansion = 12×10^{-6}/°C i) Es = 200GPa j) Density of brick lining = 20 kN/m³ k) M25 grade of concrete and Fe 415 grade steel. **(SUMMER 2024)**
- **Q.** Design a chimney of height 100m and check the stresses at base in bars. Data given: a) External diameter at top = 1.7m b) External diameter at base = 6.0m c) Shell thickness at top = 210mm d) Shell thickness at base = 500mm e) Wind Intensity = 1.8kN/m² throughout f) Thickness of fire brick lining = 100mm g) Air Gap = 100mm h) Temperature difference = 70°C i) Coefficient of thermal expansion = 11×10^{-6}/°C j) M35 grade of concrete and Fe 415 grade steel. **(SUMMER 2025 OR)**

Chapter 4 – Bunkers & Silos

Repeated Questions:

1. Bunkers vs Silos:

- **Q.** Distinguish / Give the difference between Bunkers and Silos with a neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2022 OR; WINTER 2022, 3 Marks; SUMMER 2023, 4 Marks; SUMMER 2024, 3 Marks; WINTER 2024, 3 Marks; SUMMER 2025; SUMMER 2026)**
- **Q.** Explain the differences in analysis of bunker wall and silo wall. **(SUMMER 2022, 4 Marks; WINTER 2022 OR; WINTER 2024, 3 Marks)**

2. Bunker Elements:

- **Q.** Draw appropriate figure of square or rectangular bunker and show various structural elements. [Diagram required – refer to the original question paper] **(SUMMER 2024, 4 Marks; SUMMER 2025, 7 Marks)**

3. Bunker Design (Numerical):

- **Q.** Design a circular bunker to store [20/21/22/25] tonnes of coal. Density of coal is [8/8.5/9/10] kN/m³ and angle of repose is 30°. Use limit state method of design and adopt grades M20 and Fe 415. Show reinforcement detailing with neat sketch. / Design supporting columns and draw reinforcement detailing. [Diagram required – refer to the original question paper] **(WINTER 2022, 10 Marks OR; SUMMER 2023; SUMMER 2024, 7 Marks; WINTER 2024, 10 Marks OR; SUMMER 2025)**
- **Q.** A square bunker having size [3.1m × 3.1m / 3.2m × 3.2m] is to be used to store [300kN / 350kN] coal. Density of coal is 9.5kN/m³ and angle of repose is 30°. Considering grade of concrete and steel as M20 and Fe 415 respectively, design and detail the following. (a) Side walls (b) Hopper bottom. **(SUMMER 2024; WINTER 2024)**

4. Silo Design (Numerical):

- **Q.** A cylindrical silo has an internal diameter of 7m and 20m deep (cylindrical portion) with a conical hopper bottom. The material stored is wheat with density of 8.5kN/m³. The coefficient of friction between wall and material is 0.444. The ratio of horizontal to vertical pressure is 0.40. Angle of repose is 25 degree. Design the reinforcements in the walls of silo. Adopt M20 and Fe415 grades. Adopt Janssen's theory for pressure calculations. **(SUMMER 2022 OR; WINTER 2024)**

Other Important Questions:

1. Silo Theory and Janssen's Theory:

- **Q.** Derive the expressions for finding horizontal and vertical pressure exerted by stored material of height 'h' in a Silo using Janssen's theory. **(SUMMER 2026)**
- **Q.** What are the assumptions made in Janssen's Theory for finding lateral pressures in the silos. **(SUMMER 2026, 3 Marks)**
- **Q.** What are bins? What is the purpose of constructing bins? Give classifications of bins. **(SUMMER 2026, 3 Marks OR)**
- **Q.** What are the parameters which influence the Design of Bunkers? **(SUMMER 2022, 4 Marks)**

2. Silo Design (Numerical):

- **Q.** A Silo with diameter 5.0m, height of cylindrical portion 20m and central opening of 0.5m is to be designed to store grains using M25 grade concrete and Fe500 steel. Given the following: Unit weight of grains = 9kN/m³, Angle of Internal friction, Φ = 33°, Angle of wall friction = 0.75Φ (while filling); 0.6Φ (while emptying), Pressure Ratio (ph/pv) = 0.5 (while filling). Use Janssen's Theory for pressure calculations. Design the side walls. **(SUMMER 2026)**

- **Q.** Design the hopper bottom of a silo for the data given in previous question [Q.3 (b)]. Show reinforcement detailing with a neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** A cylindrical silo has an internal diameter of 6m and 20m depth (cylindrical portion) with a conical hopper bottom having depth 2.5m and opening of 1m at bottom. The material stored is wheat with density of 7.5kN/m³. The coefficient of friction between wall and material is 0.45. The ratio of horizontal to vertical pressure is 0.40. Angle of repose is 25 degree. Materials are M20 grade concrete and Fe415 grade steel. Adopting Janssen's theory for pressure calculations carryout following (a) Design cylindrical wall (b) Design hopper bottom. **(SUMMER 2024 OR)**
- **Q.** A cylindrical silo has an internal diameter of 6m and 20m deep (cylindrical portion) with a conical hopper bottom. The material stored is wheat with density of 8kN/m³. The coefficient of friction between wall and material is 0.444. The ratio of horizontal to vertical pressure is 0.40. Angle of repose is 30°. Design the reinforcements in the walls of silo. Adopt M20 and Fe415 grades. Adopt Janssen's theory for pressure calculations. **(WINTER 2022, 10 Marks)**

3. Bunker Design (Numerical):

- **Q.** Carry out preliminary dimensioning of a rectangular Bunker of capacity 320kN used to Coal, given: Unit weight of Coal = 8kN/m³, Angle of Repose = 35°. Use M25 grade concrete and Fe500 steel. Prepare a neat sketch of bunker dimensions. [Diagram required – refer to the original question paper] **(SUMMER 2026 OR)**
- **Q.** Design the side walls and bottom hopper of a rectangular Bunker for the data given in previous question [Q.3 (b) OR]. Show reinforcement detailing with a neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2026 OR)**
- **Q.** A bunker is to be designed to store 300kN of coal for the following data: Density of coal is 8.9kN/m³ and angle of repose is 30°. Adopt grades as M20 and Fe 415 for concrete and steel respectively. Decide dimensions and prepare basic schematic diagram. [Diagram required – refer to the original question paper] **(WINTER 2025, 3 Marks OR)**
- **Q.** Design side wall for above said bunker. **(WINTER 2025, 4 Marks OR)**
- **Q.** Design hopper bottom for above said bunker. **(WINTER 2025, 7 Marks OR)**

Chapter 5 – Grid Slabs

Repeated Questions:

1. Approximate Analysis of Grid Floors:

- **Q.** Briefly explain the approximate analysis of Grid Floors according to IS: 456:2000. **(WINTER 2024; SUMMER 2025, 4 Marks OR; WINTER 2025, 4 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Write requirements for analysis of In-situ Ribbed Slab (Grid Slab) for using IS 456-2000 method. **(WINTER 2022; SUMMER 2023; SUMMER 2024 OR)**
- **Q.** Briefly explain the approximate analysis of Grid Floors according to Rankine Grashoff Method. **(SUMMER 2026, 7 Marks OR)**

2. Analysis of Grid Floor (Numerical):

- **Q.** A Reinforced Concrete Grid Floor for a hall has a size of 12m × 18m. The spacing of ribs is 1.5m centre to centre in mutually perpendicular directions. The live load on the floor is [2.5/3] kN/m². Analyze the grid floor by using Rankine Grashoff or IS method. For moments and shears. **(SUMMER 2022, 4 Marks OR; WINTER 2022; WINTER 2024, 4 Marks)**

Other Important Questions:

1. Grid Floor Design (Numerical):

- **Q.** A Grid Floor of Reinforced Concrete Slab is to be designed for the following data: The hall has a size of 12m × 18m. The spacing of ribs is 2.0m center to center in mutually perpendicular directions. The live load on the floor is 1.5kN/m². Use M20 grade Concrete and Fe415 grade steel. Decide appropriate preliminary dimensions. **(WINTER 2025, 3 Marks)**
- **Q.** Carry out analysis for data given above for Grid Floor. **(WINTER 2025, 4 Marks)**
- **Q.** Design beams for data given above for Grid Floor. **(WINTER 2025, 7 Marks)**
- **Q.** A Reinforced Concrete Grid Floor is to be designed to cover a floor area of 12m × 16m. The spacing of the ribs in mutually perpendicular directions is 2.0m c/c. Live Load on floor is 2kN/m². Adopt M25 grade concrete and Fe500 steel. Assume ends are simply supported. Analyse the Grid Floor by IS: 456:2000 Method. Design the topping slab. **(SUMMER 2026, 3 Marks)**
- **Q.** Design the Ribs of a Grid Floor for the data given in previous question [Q.5 (b)]. Show the complete reinforcement detailing of grid floor with a neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** A grid floor has following data 1) 100mm thick slab, 2) floor finish = 1.5 kN/m², 3) live load 3kN/m², 4) overall dimensions of 20m × 20m c/c, 5) 230mm wall is provided on outer periphery only and 6) 4 interior beams in both direction forming a slab panel of size 4m × 4m. Assume rib size of all beams as 300 × 1100mm. Design and detail reinforcement in central beam of 20m length. Use Rankine-Grashoff theory. **(SUMMER 2024 OR)**
- **Q.** A Reinforced Concrete Grid Floors is to be designed to cover a floor area of 12m × 16m for a Banquet Hall. The spacing of the ribs in mutually perpendicular directions is 2.0m c/c. Live Load on floor is 2kN/m². Adopt M20 grade concrete and Fe415 steel. Assume ends are simply supported. Analyse the Grid Floor by IS: 456:2000 Method or Rankine Grashoff Method. **(SUMMER 2025, 10 Marks OR)**

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