CE2401-DESIGN OF REINFORCED CONCRETE AND BRICK MASONRY

QUESTION BANK

UNIT-1

PART-A

1. **What is a Retaining wall?**
2. **What are the disadvantages of gravity retaining walls?**
3. **What are the types of retaining walls?**
4. **What is a cantilever retaining wall?**
5. **What is a counter fort retaining wall?**
6. **What are the forces acting on a retaining wall?**
7. **Define Active Earth pressure?**
8. **Define Passive earth pressure?**
9. **Give the criteria for the design of gravity retaining wall?**
10. **What are the stability conditions should be checked for the retaining walls?**
11. **Give the minimum factor of safety for the stability of a retaining wall?**
12. **If a retaining wall of 5 m high is restrained from yielding, what will be the total earth pressure at rest per metre length of wall?**
13. **A cantilever retaining wall of 7 metre height retains sand. The properties of the sand are γd= 17.66KN/m3 and γsat = 29.92 KN/m3 φ = 30°. using Rankine's theory determine active earth pressure at the base when the backfill is (i) Dry, (ii) Saturated and (iii) Submerged**
14. **What is meant by backfill?**
15. **What is meant by surcharge?**
16. **What is a gravity retaining wall?**
17. **What is meant by submerged backfill?**
18. **What is the function of counterforts in a retaining wall?**
19. **What is meant by back anchoring of retaining wall?**
20. **When is the design of shear key necessary?**
21. **Draw the deflected shape of Cantilever retaining wall?**

PART-B

1. Design a Cantilever retaining wall to retain 5m of horizontal backfill.

The Density of the soil is 17kN/m^2
Safe Bearing Capacity of the Soil=165kN/m^2
Angle of internal Friction of Soil=25^o
The Coefficient of friction between base slab and concrete=0.55
Use M20 concrete and Fe415 Steel.

2. Design a cantilever retaining wall for the following data:
Height of the wall above ground=4m
Depth of foundation=1.5m
Unit weight of earthfill=17kN/m^3
Safe Bearing Capacity of the Soil=130kN/m^2
Angle of internal Friction of Soil=20^o
The Coefficient of friction between base slab and concrete=0.45

3. Design a cantilever retaining wall to retain earth embankment 3m high above the ground level.The unit weight of earth is 18kN/m^3 and its angle of repose is 30^o, safe bearing capacity of soil is 100 kN/m^2 and the coefficient of friction between soil and concrete is 0.5.Adopt M20 concrete and Fe415 Steel.

4. A cantilever retaining wall has 4.5m high wall from the top of the base slab and retains earth with an inclined fill(20^o to the horizontal). Density of the soil retained is 15kN/m^3 and its angle of repose is 30^o. Design the base section of the wall for flexure.

5. A couterfort retaining wall 5m high above foundation level supports earth with horizontal fill.
   Safe Bearing Capacity of the Soil=200kN/m^2
   Angle of internal Friction of Soil=30^o
   The Coefficient of friction between base slab and concrete=0.5
   Unit weight of backfill is 16kN/m^3.
   Determine suitable dimension of base slab for following stability considerations.

6. Design a T shaped cantilever retaining wall for the following data.
   Height of the wall above ground 3.5m
   Depth of foundation 1.3m
   Safe Bearing Capacity of the Soil=140kN/m^2
   Angle of internal Friction of Soil=25^o
   The Coefficient of friction between base slab and concrete=0.44
   Unit weight of earthfill is 18kN/m^3.
   Adopt M20 grade concrete and Fe415 grade steel.

7. Explain the methods of designing shear key in a retaining wall

8. Design a R.C.C. cantilever retaining wall to retain the leveled earth embankment 5m high above the ground level.
   The unit weight of earth is 17kN/m^3 Angle of repose is 30^o.
   Safe Bearing Capacity of the Soil=200kN/m^2
   The Coefficient of friction between base slab and concrete=0.55
   Adopt M20 grade concrete and Fe415 grade steel.

9. a) What are the design principles involved in the different components of counterfort retaining wall.
   b) Write down the steps involved in the design of counterfort retaining wall.

10. Design stem and counterfort portion of a retaining wall for the following data.
    Height of the wall = 8.7m
    Density of soil = 18kN/m^3
    Spacing of counterfort = 3.5m
    Angle of internal friction of soil = 30^o.
    Safe Bearing Capacity of the Soil=170kN/m^2
    Adopt M20 grade concrete and Fe415 grade steel.
    Sketch the reinforcement details. Stability check is not necessary.

11. Design a counterfort retaining wall to retain earth 5m above ground level. The unit weight of earth is 16kN/m^3 and its angle of repose is 30^o, safe bearing capacity of soil is 125kN/m^2. Adopt M20 grade concrete and Fe415 grade steel.

12. A counterfort retaining wall retains earth(top level horizontal) to a height of 6m above GL and the SBC of soil at 1m below GL is 200kN/m^2. Density and angle of repose of soil is 16kN/m^3 and 30^o respectively. Co-efficient of friction between concrete and soil is 0.6. Assuming the thickness of the stem, base slab and counterfort as 300mm throughout and spacing of counterfort is 3m centre to centre. Calculate the base dimensions for stability considerations.

13. A counterfort retaining wall has a total height of 10m from foundation level. The backfill has a horizontal top. The density and angle of internal friction of soil are 19kN/m^3 and 36^o respectively. Base slab width and thickness are 6.5m and 380mm respectively. Toe width from the face of wall is 700mm. Thickness of wall is 260mm. The counterforts are spaced at 3m centre to centre thickness of counterfort is 300mm. Calculate the pressure under the base and design the toe slab.

PART-A

1. **Mention the grade of concrete which is used in the construction of water tank.**
2. **Mention the three factors that must be considered while designing a RCC tank.**
3. **Water are the types of reinforced concrete water tanks?**
4. **Mention the reinforcement details that should be provided in a water tanks.**
5. **Define the following term: Dome:**
6. **Define the following terms:**
7. **Define the following terms:**
8. **Mention the thickness and steel requirement of dome.**
9. **What are the three types of joints in water tank?**
10. **Find out the diameter of a circular tank which is having a flexible base for capacity of 200000 liters. The depth of water is to be 4m, including a free board of 200mm.**
11. **What is the foundation specification for small capacity tanks?**
12. **What are the methods available for the analysis of circular tank?**
13. **What are movement joints in water tanks?**
14. **What is contraction joint in water tanks?**
15. **What is meant by expansion joint in water tanks?**
16. **What are underground water tanks?**
17. **What are conditions under which the walls of underground water tanks designed?**
18. **What are the four components of design of underground water tanks?**
19. **What are two methods of analysis of rectangular tanks?**
20. **Where are domes used?**

PART-B

1. Design the following parts of overhead flat bottomed R.C.C cylindrical tank to store 30,000 litres of water.The top of the tank is covered with a dome. Adopt M20 concrete and Fe415 grade steel.Design
   (i) Dome
   (ii) Ring beam.
2. A square water tank 4mx4mx3m in height is supported on ground and open at top. Assuming the base of the wall as hinged, design the thickness of the wall and reinforcement for the wall, for moment in vertical direction only.
3. A square elevated water tank 3 m x 3 m height is open at top. Base of the wall may be assumed as hinged. Use M25 concrete and Fe 415 steel. Design the wall along the horizontal direction.
4. Design an overhead flat bottomed cylindrical water tank for a capacity of 100,000 litres. The depth of water is to be 3.6m. Free board = 200 mm the top of the tank is covered with a dome. Design the dome, top ring beam and side walls of the tank.
5. Design the long wall of an underground reservoir 12mx5mx4m deep. Do the curtailment of reinforcement also. Draw the neat sketch to show the reinforcement details.
6. Design an underground tank 12 m x 5 m x2.8 m deep including a free board of = 0.3 m. The dry density of soil is 16kN/m^3 and the angle of repose of dry soil is 30^0. The outside soil which is 0.3 m below the top of tank wall may be taken as fully saturated up to its full height. Design the side walls of the tank.
7. Design an underground tank of internal dimensions 8 m x 2 m x 2 m. the soil

surrounding the tank is likely to get wet. Angle of respose of soil in dry state is $30^0$and in wet state is 6^0 soil weighs 20 kN/m^3.

8. Design the underground water tank 4m x 6m x 2.2m with a freeboard of 0.2m. The weigth of subsoil is 16kN/m^3. Angle of internal friction of soil is 34^o. The subsoil is saturated at ground level. Safe bearing capacity of soil is 165kN/m^2. Use M30 concrete and Fe415 steel.

9. Design staging for a circular water tank to a capacity of 2 lakh litres. The tank is a height of 20m above ground level. Use M30 concrete and Fe415 steel.

10. Design a circular water tank for a capacity of 400 Kilolitres with flexible base. Adopt M20 concrete and Fe 415 steel. Also sketch the reinforcement details.

11. A circular water tank open at top and resisting on a rigid soil has inner diameter 3m and height 3 m. Base joint between wall and base slab shall be assumed as hinged. Using M20 concrete and Fe 415 steel, design the wall.
12. Design the side wall of a circular tank of capacity 1.5 lak litres of water. The sub soil consist of silt having angle of repose of 30^o and saturated unit weight of 18kN/m^3. The water is likely to rise up to ground level. Use M20 grade concrete Fe415 grade steel.

13. A spherical cover dome is to be provided for a circular water tank with inner diameter of 6m. Choose the rise for the dome as 1m.Live load as the dome is 1kN/m^2.Design the cover dome and its supporting ring girder.

14. Design a circular tank with flexible base for capacity of 400000 liters. The depth of water is to be 4m, including a free board of 200mm.Use M20 concrete.

15. An open rectangular tank 4m x 6m x 3m deep rests on firm ground. Design the tank. Use M20 mix.

16. Design an underground water tank 4m x 10m x 3m deep. The sub soil consist of sand having angle of repose of 30 degree and saturated unit weight of 17KN/m^3.The water table is likely to rise up to ground level. Use M20 concrete and HYSD bars. Take unit weight of water as 9.81KN/m^3.

17. Design a spherical dome over a circular beam for the following data:
    a. Inside diameter of the room=12m.
    b. Rise of the dome = 4m.
    c. Live load due to wind, snow,etc = 1.5 kN/m

    The dome has an opening of 1.6m diameter at its crown. A lantern is provided at its top, which causes a dead load of 22KN acting along the circumference of the opening. Use M20 concrete and Fe415 steel.

18. Design a conical dome roof for a room with base diameter as 12m. The live load due to wind, snow, etc may be taken as 1000N/mm^2.The height of the roof is 4m.

UNIT-3

PART-A

1. **What is a stair case.**
2. **Define tread:**
3. **Define tread Riser:**
4. **Define tread Going:**.
5. **What are the types of staircases?**
6. **What is a flight?**
7. **What is the minimum rise and tread in residential buildings?**
8. **What is the minimum rise and tread in public buildings?**
9. **Mention the places where the following footings can be used a). Single flight staircase b). Quarter turn staircase c). Dog legged staircase d). Open well staircase e). Spiral staircase?**
10. **Define flat slab.**
11. **What are all the components of flat slab?**
12. **Define drop of flat slab.**
13. **Define capital or column head.**
14. **Define panel of flat slab.**
15. **Write the different types of flat slabs?**
16. **What are the methods of analysis of flat slab?**
17. **What are all the assumptions made in equivalent frame method?**
18. **What are all the assumptions made in direct design method?**
19. **Explain about box culvert shortly.**
20. **Give the names of various types of bridges.**

PART-B

1. A Longitudinal type of a staircase spans a distance of 3.75 m c/c of beams. The flight consists of 15 steps. Take rise = 175 mm, tread is 250 mm. Assuming grade 25 concrete and Fe 415 steel, design the staircase for a live load of 5 kN/m^2. Assuming the breadth of the staircase as 1.4 m.

2. An intermediate flight of a staircase is supported only at the edges of landing (support-Perpendicular to the direction of the flight). Height between landings is 1.5m. The Flight has steps consisting of 10 risers (each rise=150mm) and a treads (each tread=250mm). The steps are supported on a waist slab. Landing is 1 m width. Support width is 300 mm each. Design the waist slab and landing for bending moment alone. Use M20 concrete and Fe 415 steel. Live load on stair is 3.0kN/m^2. Width of flight = 1.5 m.

3. Design a dog-legged staircase for a room of 4 m wide. The height between floors is 3.6 m. Use M20 concrete and Fe 415 steel.

4. Design a dog-legged stair for a building in which the vertical distance between floors is 3.6 m. The stair hall measures 2.5 m x 2.5 m. The live load may be taken as 2.5 kN/m^2. Adopt M20 concrete and Fe 415 steel.

5. A flight of a dog-legged staircase has the following details:

Going =2.25 m Landing
width = 1.25 m Raise of
a flight = 1.5 m
Support width = 300 mm
Choosing appropriate dimensions for rise and tread, and taking the flight to span longitudinally between the supports, design the flight. Assume live load as 3 kN/m^2.

6. Design a dog-legged stair for a building in which the vertical distance between the floors is 3.6m. The Stair hall measures 2.4m x 5m (inner dimensions). The live load on the stair is 3000N/m^2.Adopt M20 Grade concrete and Fe415Grade Steel.

7. Design an interior panel of a flat slab in a hotel carrying a superimposed live load of 3kN/m^2. Weight of floor finishes on the slab may be taken as 2kN/m^2.The panel is supported on 300 mm diameter circular column. Drops may be provided. The size of panel is 5mx7m.Adopt M20 concrete and Fe415 steel.

8. An interior panel of a flat slab floor is 6m x 6m along column centre lines. Live load on floor is 3kN/m^2.Supporting column diameter is 500 mm. Choosing the thickness of the slab (from stiffness criteria) and appropriate dimensions for column head and drops, calculate the design moments and shear forces. Use direct design method.

9. Design an interior panel of a flat slab for a live load of 5kN/m^2 and a column grid of 6mx6m. Columns are of 600mm diameter. Drops shall be provided. Show the reinforcement details in the flat slab. Use M20 concrete and Fe415 steel.

10. Explain the principle of design of box culvert.

UNIT-4

PART-A

1. **What is meant by yield lines?**
2. **What are the characteristic features of yield lines**?
3. **State the principle of virtual work?**
4. **What are the two methods of determining the ultimate load capacity of reinforced concrete slabs?**
5. **What is the direction of yield line in one way slab?**
6. **What is the direction of yield line in two way slab?**
7. **What is the concept of yield line method?**
8. **Who innovated yield line theory?**
9. **What is an yield line?**
10. **What is meant by an orthotropically reinforced slab?**
11. **What is meant by an isotropically reinforced slab?**
12. **Define static indeterminacy of a structure?**
13. **Define: Unit load method?**
14. **What is the absolute maximum bending moment due to a moving udl longer than the span of a simply supported beam?**
15. **State the location of maximum shear force in a simple beam with any kind of loading?**
16. **What is meant by maximum shear force diagram?**
17. **What do you understand by the term reversal of stresses?**
18. **What is the moment at a hinged end of a simple beam?**
19. **Define similitude?**
20. **Define : Trussed Beam**?

PART-B

1. Derive from principles the ultimate design moments for a rectangular simply supported slab panel using yield line approach.

2. A square interior panel of an intermediate floor is of effective dimension 5mx5m. The live load on the floor is 2.5 kN/m^2. Finishes is 1 kN/m^2. Analyse the slab using yield line approach and design the slab. Use M20 concrete and Fe 415 steel.

3. (i) Write any four characteristics of yield line?
   (ii) Find the ultimate load of the isotropically reinforced square slab simply supported on its all edges and uniformly loaded. Use virtual work method.

4. Design a rectangular slab 6m x 4m simply supported on its all edges. The live load is 5 kN/m^2.The load factors are 1.5 and 2.2 for dead and live load respectively. The ultimate moment in the longer direction is half of the short side. Use M25 concrete and Fe415 steel.

5. Derive the expression for calculating the ultimate moment (Virtual work method) for a simply supported square slab.

6. Design a circular slab of 4.5 meter diameter, simply supported along the edges, to carry a service load of 5 KN/m^2. Adopt M20 Grade concrete and Fe 415 Grade steel. Use

equilibrium method for analysis.

7. Derive from principles the ultimate design moments for a rectangular simply supported slab panel using yield line approach. Hence determine the design moments for a simply supported rectangular slab 3 m x 4 m effective, subjected to a live load (working) of 2.5 kN/m^2 and finish of 1 kN/$m^{2.}$ Assume suitable load factor.

8. A square interior panel of an intermediate floor is of effective dimension 5 m x 5 m. The live load on the floor is 2.5 kN/$m^{2.}$ Finishes is 1 kN/$m^{2.}$ Analyse the slab using yield line approach and design the slab. Use M20 concrete and Fe 415 steel.

9. Derive an expression for calculating the ultimate moment of resistance for a simply supported rectangular slab.

10. A rectangular slab 3.5 m x 5 m in size simply supported at the edges. The slab is expected to carry a service load of 3 kN/m^2 and a floor finishing load of 1 kN/m^2. Design the slab if
    (i) It is isotropically reinforced and
    (ii) It is orthotropically reinforced with $\mu = 0.75$.

11. Find the ultimate load carrying capacity of a 4 m x 6 m slab continuous on all edges if yield moments are 25 kN m/m for positive and negative moments respectively, they being uniformly loaded.

12. Find the ultimate load for isotropic of the following profiles simply supported on all edges carrying distributed load throughout the slab.
    (a) Square slab and
    (b) Triangular slab

UNIT-5

PART-A

1. **What is cross sectional area of Masonry unit?**

2. **What is bond in a brick masonry?**
3. **How will you calculating effective length, effective height and effective thickness?**
4. **What meant by lateral support?**
5. **What is the minimum thickness of basement walls?**
6. **What is the slenderness ratio for walls?**
7. **What is the slenderness ratio for walls and columns?**
8. **What is effective length of a masonry wall with respect to its support condition?**
9. **What is effective height of a masonry wall with respect to its support condition?**
10. **What is slenderness ratio in brick masonry structures?**
11. **What is slenderness ratio in brick column masonry structures?**
12. **What is reinforced brick work?**
13. **What is the thickness adopted for reinforced brick slab?**
14. **What are braced columns?**
15. **What is a column?**
16. **What are the functions of longitudinal reinforcement in column?**
17. **What are the functions of transverse reinforcement in column?**
18. **What are the two types of column?**
19. **What is a short column?**
20. **What is a long column?**

PART-B

1. Determine the allowable axial load on column 300mm x60mm constructed in first class brick work in CM 1:6 using modular bricks 200mm x 10mm x 100mm. the height of pier between the footing and top of slab is 5.2m. the strength of units may be assumed as 10.5MPa.
2. Design a interior load bearing wall of a two storied building to carry 150mm thick R.C.C slab with 3m ceiling height. The wall is unstiffened and supports 4m wide span. Take
   Live load on floor and floor is $2kN/m^2$
   Weight of floor finish=$1kN/m^2$ Weight of Terrace=$1.8kN/m^2$
   Unit Weight of Masonry=$19.2kN/m^3$.
3. Design a solid wall of a single storey Mill building that is 3000mm in height, securely tied with roof and floor units and supporting two beams on either side of it that exert reactions of 30kN and 20kN. The thickness of the wall is 230mm. the beam bears on the wall is 115mm. Assume uniform bearing stress. Neglect the load due self-weight.
4. Design a solid square masonry column of height 2000mm to cary an axial load of 150 kN. The column is tied at the top and bottom. Include the self weight of the column for the design.
5. A single room building 3mx7m is provided with a brick masonry wall supporting a RC roof 150mm thick. The slab supports a live load of $1.5kN/m^2$ along with a finish of $2kN/m^2$. A parapet 750mm in height and 230mm thick is provided all around. Height of wall from basement to the underside of the roof is 3m. assuming that there are no openings in the walls design the thickness of long wall. Brick strength of 5 N/mm^2 and 1:5 mortar mix are to be used. Nominal sized bricks are to be used.

6. A brick masonry pier 345mm x 345mm of effective dimension supports a roof truss. Height of the pier from basement to the underside of roof truss is 3.5m; brick strength 5N/mm^2 and 1:5 mortar mix are used. Calculate the capacity of the pier. Nominal bricks are used.
7. A masonry wall is subjected to an axial load of 180 kN and the height of the wall is 3.6m.design the walls.
8. A masonry wall is subjected to an axial load of 150 kN and bending moment of 30 kNm. The height of the wall is 4m.design the walls.
9. Write short note on:
   (i) Classification of walls.
   (ii) Effective length and effective height of walls
   (iii) Permissible stress in brick masonry.
10. Design a solid square masonry column of height 2.5m to carry an axial load of 100 kN.
11. Design a masonry pier with an effective height of 2.7m to carry a load of 120kN.
12. Design an interior cross wall of a two storied building to carry 100mm thick RC slab with 3 m ceiling height. The wall is unstiffened and it supports 2.65m wide slab. 1.5kN/m^2
    Live load on roof: 2.0kN/m^2
    Live load on floor:
    Weight of floor 2.0 kN/m^2 finish: 0.2kN/m^2
    Weight of terrace: