CE1401 - DESIGN OF REINFORCED CONCRETE & BRICK MASONRY STRUCTURES

(FOR VII – SEMESTER)

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UNIT – I

RETAINING WALLS

1. What is a Retaining wall?

Retaining walls are generally used to retain earth or such materials to maintain unequal levels on its two faces. The soil on the back face is at a higher level and is called back fill. Retaining wall are extensively used in the construction of basements below ground level, wing walls of bridge and to retain slopes in hilly terrain roads.

2. What are the disadvantages of gravity retaining walls?

Gravity walls of stone masonry were generally used in the earlier days to the height of the earth fill. The advent of reinforced concrete has resulted in thinner retaining walls.

3. What are the types of retaining walls?

Retaining wall can be classified structurally as

1. Cantilever retaining wall
2. Counter fort retaining wall

4. What is a cantilever retaining wall?

The most common and widely used retaining wall is of cantilever type. Vertical stem resisting earth pressure one side and the slab bends like a cantilever. The thickness of the vertical slab is large at the bottom and decreases towards the top in proportion to the varying soil pressure.

5. What is a counter fort retaining wall?

Counter fort retaining walls are used for large heights exceeding 5 mts of earth fill. In counter fort retaining wall the vertical stem is designed as a continuous slab spanning between the counter forts. Counter forts are designed as cantilever beams from the base slab.

6.What are the forces acting on a retaining wall?

Forces acting on a retaining wall are

1. Lateral earth pressure due to the back fill
2. Vertical forces including weight of soil, stem, heel, toe, and soil fill bbove the toe.
3. The soil pressure developed to resist the earth pressute and other vertical forces acting on the heel and toe.

7. Define Active Earth pressure.

If the soil exerts a push against the wall by virtue of its tendency to slip laterally and seek its natural slope (angle of repose) thus making the wall to move slightly away from the back filled soil mass. This kind of pressure is known as AEP.

8. Define Passive earth pressure.

The pressure or resistance which soil develops in response to movement of the structure towards it is called the Passive Earth Pressure.

9. Give the criteria for the design of gravity retaining wall.

1. Maximum pressure should not exceed the bearing capacity of soi (Base width).
2. No tension should be developed any where in the wall

$$e < \frac{b}{6} \qquad \text{i.e. } \bar{x} \le \frac{2b}{3}$$

3. The wall must be safe against sliding.
4. The wall must be safe against sliding.
5. The wall must be safe against overturning.

10. What are the stability conditions should be checked for the retaining walls

The stability of retaining walls should be checked fagainst the following conditions

The wall should be stable against sliding

(a) The wall should be stable against Overturning

(b) The wall should be stable against Bearing capacity failure.

11. Give the minimum factor of safety for the stability of a retaining wall.

(a) The wall should be stable against sliding = 1.5

(b) The wall should be stable against Overturning

For Granular Backfill = 1.5

For cohesive backfill = 2.0

(c) The wall should be stable against Bearing capacity failure.

For Granular Backfill = 1.5

For cohesive backfill = 2.0

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? Given: the back fill is cohesion less soil having $\phi = 30°$ and $\gamma = 18$ kN/m^3.

Solution

$C_o = 1 - \sin\phi = 1 - \sin 30° = 0.5$

$$P_o = \frac{1}{2} K_o \gamma H^2 = \frac{1}{2} x0.5x18x5^2 = 112.5 kN/m \text{ length of wall}$$

13. A cantilever retaining wall of 7 metre height retains sand. The properties of the sand are γ_d = 17.66KN/m3 and γ_{sat} = 29.92 KN/m3 $\phi = 30°$. using Rankine's theory determine active earth pressure at the base when the backfill is (i) Dry, (ii) Saturated and (iii) Submerged.

Submerged density

$\gamma b = \gamma sat - \gamma w = 20.92\text{-}9.81 = 11.1 kN/m3$

for $\phi = 30$, $C_A = \frac{1-\sin\phi}{1+\sin\phi} = \frac{1-\sin 30^\circ}{1+\sin^\circ} = \frac{1}{3}$

Active earth pressure at the base is

(i) for dry backfill,

$$P_a = C_A\gamma_d H = \frac{1}{3} x17.66x7 = 41.2kN/m^2$$

(ii) for saturated backfill,

$$P_a = C_A\gamma_{sat} H = \frac{1}{3} x20.9x7 = 48.76kN/m^2$$

(iii) for submerged backfill,

$$P_a = C_A\gamma_b H = \frac{1}{3} x11.1x7 = 25.9kN/m^2$$

14. What is meant by backfill?

The material retained or supported by a retaining wall is called backfill.

15. What is meant by surcharge?

The position of the backfill lying above the horizontal plane at the elevation of the top of a wll is called the surcharge.

16. What is a gravity retaining wall?

A gravity retaining wall is the one in which the earth pressure exerted by the backfill is resisted by dead weight of the wall, which is either made of masonry or mass concrete.

17. What is meant by submerged backfill?

The sand fill behind the retaining wall saturated with water is called submerged backfill.

18. What is the function of counterforts in a retaining wall?

The stem of the counterfort retaining wall acts as a continuous slab supported on counterforts. The counterforts take reactions both from the stem as well as the heel slab. Since the active earth pressure on stem acts outwards, and net pressure heel slab acts downwards, the counterforts are subjected to tensile stresses along the outerface of the counterforts.

19. What is meant by back anchoring of retaining wall.

When the height of retaining wall is much more, it becomes uneconomical to provide counterforts. In order to reduce the section of stem etc. in the high retaining walls, the stem may be

anchored at its back. The anchor practically takes all the earth pressure and B.M and S.F. in the stem are greatly reduced.

20. When is the design of shear key necessary?

When the wall is unsafe in sliding, shear key will have to be provided.

UNIT – II

1. **Mention the grade of concrete which is used in the construction of water tank.**

   Richer concrete mix of grades M20 to M30 are commonly used in the construction of water tanks. High quality concrete, in addition to providing water tightness, also has higher resistance to tensile stresses developed in the tank walls.

2. **Mention the three factors that must be considered while designing a RCC tank.**

   i. Strength
   ii. Water tightness
   iii. Overall stability

3. **Water are the types of reinforced concrete water tanks?**

   i.Tanks resting on ground
   ii.underground tanks
   iii.elevated water tanks.

4. **Mention the reinforcement details that should be provided in a water tanks.**

   Minimum area of steel is 0.3 percent of gross area of section upto 100mm thick, reduced to 0.2 percent in section up to 450mm thick. For sections above 225mm thick, provide two layers of reinforcement. The percentage of reinforcement in base or floor slab resisting directly on ground must be not less than 0.15% of the concrete section.

   The minimum cover to all reinforcement should be not less than 25mm or the diameter of the bar whichever is greater.

5. **Define the following term:**

   Dome:

   A Dome is defined as a thin shell generated by the revolution of a regular curve about one of its axes.

6. **Define the following terms:**

   i. Latitude:

   The circle of each ring in a dome is called Latitude.

   ii. Meridian circle:

   The circle drawn through two diametrically opposite points on a horizontal diameter and the crown is known as meridian circle.

7. **Define the following terms:**

   i. Radial:

   The joint between successive horizontal rings is called radial.

   ii. Meridian thrust:

   The reaction between the rings is tangential to the curved surface giving rise to compression along the medians. The compressive stress is called meridional thrust or meridional compression.

8. **Mention the thickness and steel requirement of dome.**

A minimum thickness of 7.5cm is provided to protect steel. Minimum steel requirement is 0.15% for mild steel bars and 0.12% for HYSD bars of the sectional area in each direction meridionally as well as along the latitudes.

9. What are the three types of joints in water tank?

i. Movement joints
   a. Contraction
   b. Expansion
   c. Sliding
ii. Construction joints
iii. Temporary open joints

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.

Effective depth of water = 4 - 0.2
= 3.8m

Let D be the inside diameter of the tank.

Volume, $V = \Pi/4 \times D^2 \times \text{depth}$

$(200000 \times 10^3)/10^6 = \Pi/4 \times D^2 \times 3.8$

$D = \sqrt{(200 \times 4)/(\Pi \times 3.8)}$

$D = 8.18m$

$D = 8.2m$

11. What is the foundation specification for small capacity tanks?

For small capacity tanks individual footings for columns can be provided. Infact, the type of footing will depend upon the nature of soil and type of staging. In case of low lying areas of low safe bearing capacity with high ground water table, pile footings are provided.

In any case of foundation slab, lean mix of 1:4:8, 150mm thick may be provided as levelling course.

12. What are the methods available for the analysis of circular tank?

i. IS code method
ii. Reissner's method
iii. Carpenter's method
iv. Approximate method

13.What are movement joints in water tanks?

These joints require the incorporation of special materials in order to maintain water-tightness while accommodating relative movement between the side of the joints. All movement joints are essentially flexible joints.

14.What is contraction joint in water tanks?

A contraction joint is a typical movement joint which accommodates the contraction of the concrete.

15.What is meant by expansion joint in water tanks?

It is a movement joint with complete discontinuity in both reinforcement and concrete, and is intended to accommodate either expansion or contraction of the structure.

16.What are underground water tanks?

Underground water tanks are used for storage of water received from water supply mains operating at low pressures, or received from other source.

17.What are conditions under which the walls of underground water tanks designed?

(a) Tank full with water, with no earthfill outside.
(b) Tank empty, with full earth pressure due to saturated earthfill.

18.What are the four components of design of underground water tanks?

(i) Design of long walls
(ii) Design of short walls
(iii) Design of roof slab
(iv) Design of base slab

19.What are two methods of analysis of rectangular tanks?

(i) Approximate analysis
(ii) Exact analysis based on elastic theory

20.Where are domes used?

(i) Roof of circular areas
(ii) Circular tanks
(iii) Hangers
(iv) Exhibition halls, auditoriums and planitoriums and
(v) Bottoms of tanks, bins and bunkers.

UNIT – III

1.What is a stair case.

A staircase consists of a number of steps arranged in a series, with landings at appropriate locations, for the purposes of giving access to different floors of a building.

2. Define tread:

Tread: The horizontal portion of a step was the foot rests is referred to, as tread.250 to 300 mm is the typical dimensions of a tread.

3. Define tread

Riser: Riser is the vertical distance between the adjacent treads or the vertical projection of the step with value of 150 to 190 mm depending upon the type of building.

4. Define tread

Going: Going is the horizontal projection of an inclined flight of steps between the first and last riser.

5. What are the types of staircases?

They are broadly classified as

i. Straight stair
ii. Quarter turn stair
iii. Half turn stair
iv. Dog legged stair
v. Open newer stair with quarter space landing
vi. Geometrical stairs such as circular stair, spiral stair, etc.

6. What is a flight?

A flight is the length of the staircase situated between two landings. The number of steps in a flight may vary between 3 to 12.

7. What is the minimum rise and tread in residential buildings?

In residential buildings, the rise may vary between 150mm to 180mm tread between 200mm to 250mm.

8. What is the minimum rise and tread in public buildings?

In public buildings, the rise may vary between 120mm to 150mm tread between 200mm to 300mm.

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

Single flight staircase: Single flight staircase is used in cellars or attics where the height between floors is small and the frequency of its use is less.

Quarter turn staircase: Quarter turn staircase flight generally runs adjoining the walls and provides uninterrupted space at the centre of the room. Generally used in domestic houses where floor heights are limited to 3m.

Dog legged staircase: Dog legged staircase is generally adopted in economical utilization of available space.

Open well staircase: Open well staircases are provided in public buildings where large spaces are available.

Spiral staircase: In congested locations, where space availability is small, Spiral stairs are provided.

10.Define flat slab.

A flat slab is a typical type of construction in which a reinforced slab is built monolithically with the supporting columns and is reinforced in two or more directions, without any provision of beams.

11.What are all the components of flat slab?

i. Drop of flat slab
ii. Capital or column head
iii. Panel

12.Define drop of flat slab.

Drop is that part of the slab around the column, which is of greater thickness than the rest of the slab.

13.Define capital or column head.

Sometimes the diameter of a supporting column is increased below the slab. This part of column with increased diameter is called column head.

14.Define panel of flat slab.

It is the area enclosed between the centre lines connecting adjacent columns in two directions and the outline of the column heads.

15.Write the different types of flat slabs?

i. Slabs without drops and column heads
ii. Slabs without drops
iii. Slab with drops and column with column head

16.What are the methods of analysis of flat slab?

(i) The direct design method
(ii) The equivalent frame method

17.What are all the assumptions made in equivalent frame method?

i. The structure is considered to be made of equivalent frames longitudinally and transversely.

ii. Each frame is analysed by any established method like moment distribution method.
iii. The relative stiffness is computed by assuming gross cross section of the concrete alone in the calculation of the moment of inertia.
iv. Any variation of moment of inertia along the axis of the slab on account of provision of drops should be considered.

18.What are all the assumptions made in direct design method?

(i) There shall be minimum of three continuous spans in each direction.
(ii) The panel shall be rectangular, and the ratio of the longer span to the shorter span within a panel shall not be greater than 2.0.

19. Explain about box culvert shortly.

A box culvert is continuous rigid frame of rectangular section in which the abutment and the top and bottom slabs are cast monolithic. A box culvert is used where a small drain crosses a high embankment of a road or a railway or a canal- specially when bearing capacity of soil is low.

20. Give the names of various types of bridges.

i. Solid slab bridge or deck slab bridge.
ii. Deck girder bridge or T-beam bridge.
iii. Balanced cantilever bridge.
iv. Rigid frame culvert.
v. Arch bridge.
vi. Bowstring grider bridge.
vii. Continuous girder or arch bridge.

UNIT - IV

YIELD LINE THEORY

1.What is meant by yield lines?

The failure of reinforced concrete slabs of different shapes such as square, rectangular, circular with different types of edge conditions is preceded by a characteristic pattern of cracks, which are generally referred to as yield lines.

2. **What are the characteristic features of yield lines**?
   - i. Yield lines end at the supporting edges of the slab
   - ii. Yield lines are straight
   - iii. A yield line or yield line produced passes through the intersection of the axes of rotation of adjacent slab elements.
   - iv. Axes of rotation generally lie along lines of supports and pass over any columns.

3. State the principle of virtual work.

If a deformable structure in equilibrium under the action of a system of external forces is subjected to a virtual deformation compatible with its condition of support, the work done by these forces on the displacements associated with the virtual deformation is equal to the work done by the internal stresses on the strains associated with this deformation.

4. What are the two methods of determining the ultimate load capacity of reinforced concrete slabs?

(i) Virtual work method (ii) Equilibrium method

5. What is the direction of yield line in one way slab?

In one way slab, the direction of yield line is perpendicular to the direction of steel.

6. What is the direction of yield line in two way slab?

In two way slab, the direction of yield line is not perpendicular to the direction of steel.

7. What is the concept of yield line method?

In the yield line method, the computation of ultimate load is based on the pattern of yield lines that are developed in the slabs under conditions approaching collapse.

8. Who innovated yield line theory?

This method was innovated by Ingerslav (1923) and was greatly extended and advanced by Johanssen.

9. What is an yield line?

A yield line is defined as a line in the plane of the slab across which reinforcing bars have yielded and about which excessive deformation under constant limit moment continues to yield leading to failure.

10. What is meant by an orthotropically reinforced slab?

If the reinforcement in the two directions is not the same, it is said to be orthotropically reinforced slab.

11. What is meant by an isotropically reinforced slab?

The ultimate moment of resistance in an isotropically reinforced slab, in any direction, is the same.

12. Define static indeterminacy of a structure.

If the conditions of statics i.e., $\Sigma H=0$, $\Sigma V=0$ and $\Sigma M=0$ alone are not sufficient to find either external reactions or internal forces in a structure, the structure is called a statically indeterminate structure.

13. Define: Unit load method.

The external load is removed and the unit load is applied at the point, where the deflection or rotation is to found.

14. What is the absolute maximum bending moment due to a moving udl longer than the span of a simply supported beam?

When a simply supported beam is subjected to a moving udl longer than the span, the absolute maximum bending moment occurs when the whole span is loaded.

$$M_{max\ max} = \frac{wl^2}{8}$$

15. State the location of maximum shear force in a simple beam with any kind of loading.

In a simple beam with any kind of load, the maximum positive shear force occurs at the left hand support and maximum negative shear force occurs at right hand support.

16.What is meant by maximum shear force diagram?

Due to a given system of rolling loads the maximum shear force for every section of the girder can be worked out by placing the loads in appropriate positions. When these are plotted for all the sections of the girder, the diagram that we obtain is the maximum shear force diagram. This diagram yields the 'design shear' for each cross section.

17.What do you understand by the term reversal of stresses?

In certain long trusses the web members can develop either tension or compression depending upon the position of live loads. This tendancy to change the nature of stresses is called reversal of stresses

18. What is the moment at a hinged end of a simple beam?

Moment at the hinged ends of a simple beam is zero.

19.Define similitude.

Similitude means similarity between two objects namely the model and the prototype with regard to their physical characteristics:

- Geometric similitude is similarity of form

- Kinematic similitude is similarity of motion
  Dynamic and/or mechanical similitude is similarity of masses and/or forces

20. Define : Trussed Beam.

A beam strengthened by providing ties and struts is known as Trussed Beams.

UNIT - V
BRICK MASONRY

1. What is cross sectional area of Masonry unit?

Net cross sectional area of a masonry unit shall be taken as the gross cross sectional area minus the area of cellular space. Gross cross sectional area of cored units shall be determined to the outside of the coring but cross sectional area of groves shall not be detucted from the gross cross sectional area to obtain the net crossectional area.

2. What is bond in a brick masonry?

Arrangements of masonry units in successive courses to tie the masonry together both longitudinally and transversly; the arrangement is usually worked out to ensure that no vertical joint of one course is exactly over the one in the next course above or below it, and there is maximum possible amount of lap.

3.How will you calculating effective length, effective height and effective thickness?

The height of a wall to be column to be considered slenderness ratio. The length of a wall to be column to be considered slenderness ratio. The thickness of a wall or column to be considered for calculating slenderness ratio.

4.What meant by lateral support?

A support which enables a masonry element to resist lateral and/or restrains lateral deflection of a masonry element at the point of support

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5.What is the minimum thickness of basement walls?

S.No	Minimum thickness of basement wall (nominal) cm	Height of the ground above basement floor level with wall loading (permanent load)	
		More than 50kN/m (m)	More than 50kN/m (m)
1	40	2.50	2.00
2	30	1.75	1.40

6. What is the slenderness ratio for walls?

For a wall, Slenderness ration shall be effective height divided by effective thickness or effective length divided by the effective thickness is less.

7. What is the slenderness ratio for walls and columns?

For column slenderness ration shall be taken to be the greater of the ratios of effective heights to the respective effective thickness in the two principal directions. Slenderness ratio for a load-bearing column shall not exceed 12

8. What is effective length of a masonry wall with respect to its support condition?

Effective length of a masonry wall varies dpending on its support conditions as below

S.No	Conditions of support	Effective length
1	Where a wall is continuous and is supported by cross wall, and there is no opening within a distance of H/8 fro the face of cross wall	0.8L
2	Where a wall is supported by a cross wall at one end and continuous with cross wall at other end	0.9L
3.	Where a wall is supported at each end by cross wall	1.0L
4	Where a wall is free at one and continuous with a cross wall at the other end	1.5L
5.	Where a wall is free at one end and supported at the other end by a cross wall	2.0L

9. What is effective height of a masonry wall with respect to its support condition?

S.No	Conditions of support	Effective Height
1	Lateral as well as rotational restraint at top and bottom	0.75 H
2	Lateral as well as rotational restraint at one end and only restrained at the other	0.85 H
3.	Lateral restraint without rotational restraint on both ends	1.00 H
4	Lateral as well as rotational restraint at bottom but have no restraints at top	1.50

10. What is slenderness ratio in brick masonry structures?

In brick masonry structures

For a wall slenderness ratio shall be the effective height divided by the effective thickness or effective length divided by the effective thickness which ever is less.

11. What is slenderness ratio in brick column masonry structures?

For a column slenderness ratio shall be taken to be the greater of the ratios of effective height s to the respective effective thickness in the two principal directions. Slenderness ratio of a load-bearing column shall not exceed 12.

12. What is reinforced brick work?

Reinforced brickwork is a typical type of construction in which the compressive strength of bricks is utilized to bear the compressive stress and steel bars are used to bear the tensile stresses in the slab.

13. What is the thickness adopted for reinforced brick slab?

The thickness of slab may be kept as 100mm to 200mm.

14. What are braced columns?

If lateral supports are provided at the ends of the column, the lateral supports are borne directly by the lateral supports. Such columns are known as braced columns.

15. What is a column?

A column may be defined as a member carrying direct axial load which causes compressive stresses of such magnitude that these stresses largely control its design.

16. What are the functions of longitudinal reinforcement in column?

i. To share the vertical compressive load, thereby reducing the overall size of the column.
ii. To resist tensile stresses caused in the column.
iii. To prevent sudden brittle failure of the column.

17. What are the functions of transverse reinforcement in column?

(i) To prevent longitudinal buckling of longitudinal reinforcement
(ii) To resist diagonal tension caused due to transverse shear due to moment
(iii)To impart ductility of the column

18. What are the two types of column?

(i) Short column (ii) Long or slender column.

19. What is a short column?

When the ratio of the effective length of the column to its least lateral dimension is less than 12, it is termed as a short column.

20. What is a long column?

When the ratio of the effective length of the column to its least lateral dimension is greater than 12, it is termed as a long column.

Part – B Questions

1. Explain the steps to be followed in proportioning and design of retaining walls.

2. Design a reinforced concrete cantilever retaining wall to retain earth level with the top of the wall to a height of 5.5 m above ground level. The density of soil at site is 17 KN/Cu.mts with a safe bearing capacity of 120 KN/sq.mts. Assume the angle of shearing resistance of the soil as 35 degrees. Further assume a coefficient of friction between soil and concrete as 0.55. Adopt M20 grade concrete and Fe415 HYSD bars.

3. A Cantilever type retaining wall is to be designed to support a bank of earth 4m above the ground level on the toe side of the wall. The backfill surface is inclined at an angle of 15 degrees with the horizontal. Assume that good soil is available for foundations at a depth of 1.25m below the ground level with a safe bearing capacity of 160KN/m^2 and an angle of shearing resistance of 30 degrees .Assume co-efficient of friction between soil and concrete as 0.5,Adopt M-20 grade concrete and Fe-415 HYSD reinforcement. Assume the unit weight of soil as 16kN/m^3.

4.Design a counter fort type retaining wall to support an earth fill of 7.5m above ground level. The foundation depth may be taken as 1.5m below the ground level. The safe bearing capacity of soil at site is 150KN/m^2.Unit weight of soil may be taken as 16KN/m^3 and an angle of shearing resistance of 30 degrees. Assume the value of coefficient of friction as .55.Adopt M-20 grade concrete and Fe-415 HYSD bars. Sketch the details of reinforcements in the retaining wall.

5.Design a cantilever retaining wall to retain earth with a backfill sloped 20 degrees to the horizontal .The top of the wall is 5.5m above the ground level. Assume the depth of foundation as 1.2 m below the ground level with a safe bearing capacity of capacity of 120Kn/m^3.The unit weight of backfill is 18KN/m^3 and an angle of shearing resistance of 35 degrees .Also assume the coefficient of friction between soil and concrete as 0.55.Adopt M-20 grade concrete and Fe-415HYSD steel bars.

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

7. 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.

8. 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.

9. Design the side wall of a circular tank of capacity1.5 lakh litres of water. The depth of the tank is limited to 2.5m. The joint between the wall and base as flexible. The base slab rest on the ground. Use M 20 grade concrete.

10. Design a spherical dome over a circular beam for the following data:

a. Inside diameter of room = 12m
b. Rise of dome = 4m
c. Live load due to wind, snow,etc = 1.5 KN/m^2

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.

11. 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.

12.Design one of the flights of stairs of a school building spanning between landing beams to suit the following data.

i. Type of staircase : waist slab type
ii. Number of steps = 12
iii. Tread T =300mm
iv. Riser R =160mm
v. Width of landing beams = 400mm
vi. Materials: M-20 concrete and Fe-415 HYSD bars.

13.Design a dog-legged stair for a building in which the vertical distance between floors is 3.6m.The stair hall measures 2.5m x 5m.The live load may be taken as 2500N/mm^2.Use M20 concrete, and HYSD bars.

14.Design the interior panel of a flat slab 5.6m x 6.6m in size, for a super imposed load of 7.75kN/m^2.Provide two-way reinforcement. Use M20 concrete and Fe 415 steel.

15.Design the interior panel of a flat slab for a warehouse to suit the following data:

i. Size of warehouse 24m x 24m divided into panels of 6m x 6m.
ii. Loading class-5kN/m^2.
iii. Materials: M-20 Grade concrete.
iv. Fe-415 grade HYSD bars.

16.Design a box culvert having inside dimensions 3.5m x 3.5m.The box culvert is subjected to a superimposed dead load of 12000N/m^2 and a live load of 45000N/m^2 from the top. Assume unit weight of soil as 18000N/m^3 and angle of repose of 30degree.Use M20 concrete and Fe415 steel.

17.Design a solid slab bridge for class A loading for the following data.

Clear span = 4.5m

Clear width of road ways = 7m

Average thickness of wearing coat = 80mm

Use M_{20} mix. Take unit weight of concrete as 24000N/m^3

18. Explain the factors to be considered while designing brick masonry with respect to stability and lateral supports on the structure.
19. What are the factors to be considered while determining the effective height of wall and columns and effective length of walls?
20. Explain the design procedure to design axially and eccentrically loaded brick walls
21. Design an interior panel of a flat slab, 5.5mx5.5m for a live load of 5000 N/m^2. Use M_{20} grade concrete and Fe $_{415}$ grade steel.
22. Derive from principles the ultimate design moments for a rectangular simply supported slab panel using yield line approach.
23. 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 M_{20} concrete and Fe $_{415}$ steel.
24. Design a solid square masonry column of height 2000mm, to carry an axial load of 150KN. The column is tied at the top and bottom. Include the self weight of the column for the design.
25. Design a solid wall of a single storey mill building that is 3000m in height, securely tied with roof and floor units and supporting two beams on either side of it that exerts 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 to self-weight.