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QUESTION BANK

Name of the Department : **Civil Engineering**

Subject Code & Name : **CE8703 & Structural Design and Drawing**

Year & Semester : **IV & VII**

UNIT I RETAINING WALLS

PART-A

1. What are the types of retaining walls? (AUC Nov/Dec-2011)

i. Gravity retaining wall
ii. Cantilever retaining wall
iii. Counterfort retaining wall
iv. Buttress retaining wall
v. Basement or foundation wall

2. Name the two important stability aspects? (AUC Nov/Dec-2011, 12, 13)(May/Jun-2012)

i. Stability against overturning
ii. Stability against sliding
iii. Stability of foundation base

3. What is gravity retaining wall? (AUC Nov/Dec-2012)

A gravity wall made of plain concrete or brick masonry. The stability of the wall is maintained by its weight.it is generally made up to a height of 3m of wall.

4. How the vertical stem of a counterfort retaining wall is designed? (AUC May/Jun-2012)

- The stem is designed as a continuous slab with span equal to the spacing of counterforts. The spacing of counterforts may vary from 2.5m to 4m.maximum load on stem is at its lowest portion due to maximum horizontal earth pressure.
- Consider one meter height of vertical slab and design for maximum moments. The maximum negative moment at the end support may be taken as wl2/10 and that at intermediate supports as wl2/12, where l is the span and w is the earth pressure intensity at the lowest portion of vertical slab.
- The reinforcement curtailed towards the top. The section is checked for shear and end anchorage.

5. What is the structural action between cantilever and counterfort type retaining wall? (AUC May/Jun-2013)

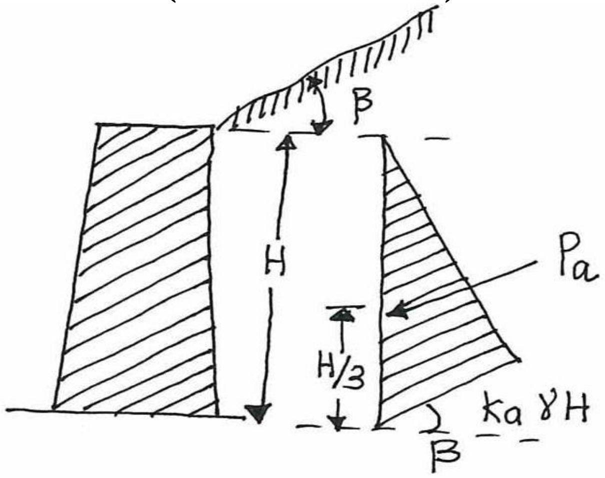
In cantilever retaining wall the pressure and other forces are withstand by the stem of the retaining wall and base slab. In counterfort retaining wall is provided the height of retaining wall is more than 6m.the walls also provided perpendicular to stem wall. The counterfort act as support to stem and heel slab.

6. What is the function of weep hole in retaining wall construction? (AUC May/Jun-2013)

The weep hole is provided in the retaining wall for the purpose of water distribution through the hole from the back fill materials.

The weep hole is act as drainage in the hilly side retaining walls due to the rain water.

7. A cantilever retaining wall supports an inclined backfill. Sketch the distribution of active earth pressure on the stem. (AUC Nov/Dec-2011)



8. 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 walls are extensively used in the construction of basements below ground level, wing walls of bridge and to retain slopes in hilly terrain roads.

9. What are the forces acting on retaining wall?

- Self-weight of retaining wall
- Weight of soil above the foundation base
- Earth pressure on retaining wall
- Surcharge
- Soil reaction on the footing
- Frictional force on the footing due to sliding.

10. 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.

11. What are the types of retaining walls?

Retaining wall can be classified structurally as

i. Cantilever retaining wall
ii. Counter fort retaining wall

12. 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.

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

14. What are the forces acting on a retaining wall?
Forces acting on a retaining wall are
- Lateral earth pressure due to the back fill
- Vertical forces including weight of soil, stem, heel, toe, and soil fill above the toe.
- The soil pressure developed to resist the earth pressure and other vertical forces acting on the heel and

15. 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 active earth pressure.

16. 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.

17. What are the stability conditions should be checked for the retaining walls?
The stability of retaining walls should be checked against the following conditions The wall should be stable
(a) The wall should be stable against Overturning
(b) The wall should be stable against bearing capacity failure.

18. What is meant by backfill?
The material retained or supported by a retaining wall is called backfill.

19. What is meant by surcharge?
The position of the backfill lying above the horizontal plane at the elevation of the top of a wall is called the surcharge.

20. 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.

21. What is meant by submerged backfill?
The sand fill behind the retaining wall saturated with water is called submerged backfill.

22. 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.

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

24. When is the design of shear key necessary?
When the wall is unsafe in sliding, shear key will have to be provided.

PART-B

1) Design a cantilever retaining wall to retain earth embankment 4m height above ground level the density of earth is 18kN/m3 and its angle of repose is 30 degrees. The embankment is horizontal at its top. The safe bearing capacity of the soil may be taken as 18kN/m2 and the co efficient of friction between soil and concrete is 0.5.adopt M20 grade concrete and Fe415 HYSD bars. (AUC May/Jun-2012, 13) (AUC Nov/Dec-2011, 12, 13)

2) Design a counterfort type retaining wall to suit the following data:
Height of wall above ground level=6m
S.B.C. of soil at site=160kN/m2
Angle of internal friction=33 degrees
Density of soils=16 kN/m3
Spacings of counterforts=3m c/c
Materials=M20 grade concrete
Fe415 HYSD bars
Sketch the details of reinforcements in details in the wall. (AUC May/Jun-2012, 13)
(AUC Nov/Dec-2011, 12, 13)

UNIT II FLAT SLAB AND BRIDGES

PART-A

1. Define flat slab. (AUC May/Jun-2013)
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.

2. What is the thickness of flat slab with drops and without drops? (AUC May/Jun-2013)

- The thickness of the drop shall be 1.25 to 1.5 times the thickness of the slab.
- The thickness of the flat slab without drop is less than 125mm.

3. Distinguish between one way shear and punching shear in flat slabs. (AUC Nov/Dec-2013)
The one way shear is located near the column head due to the shear force on the joint.

Punching shear is located the panels for the shear is created by the loads.

4. What are the limitations of direct design method of flat slabs? (AUC May/Jun-2012) (AUC Nov/Dec-2011)
There must be at least three continuous spans in each direction.

The panels should be rectangular and the ratio of longer span to shorter span within a panel shall not be greater than 2.0.

The successive span length in each direction shall not differ by more than one third of the longer span. The end spans may be shorter but not longer than the interior spans.

The design live load should not exceed three times the design dead load.

5. Write the different types of flat slabs? (AUC May/Jun-2013)

- Slabs without drops
- Slab with drops and column with column head

6. What do you mean by column strip and middle strip in flat slab? (AUC Nov/Dec-2012)
Column strip is a design strip having a width of 0.25L2 but not greater than 0.25 L1 on each side of the column center line where L1 is the span in the direction, moments are being determined, measured center to center of supports and L2 is the span traverse to L1 measured center to center of the support.
Middle strip is a design strip bounded on each of its opposite sides by the column strip

7. What are all the components of flat slab?
Drop of flat slab

Capital or column head

8. 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.

9. 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.

10. Define panel of flat slab.
It is the area enclosed between the center lines connecting adjacent columns in two direction sand the outline of the column heads.

11. What are the methods of analysis of flat slab?
The direct design method

The equivalent frame method

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

- The structure is considered to be made of equivalent frames longitudinally and transversely.
- Each frame is analyzed 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
- Any variation of moment of inertia along the axis of the slab on account of provision of drops
- Slabs without drops and column heads calculation of the moment of inertia should be considered.

13. What are all the assumptions made in direct design method?
There shall be minimum of three continuous spans in each direction.

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.

14. Give the names of various types of bridges.

- Solid Slab Bridge or deck slab bridge.
- Deck Girder Bridge or T-beam Bridge.
- Balanced cantilever bridge
- Rigid frame culvert.
- Bowstring Girder Bridge.
- Continuous girder or arch bridge.

PART-B

1. Design the interior panel of a flat slab with drops for an office floor to suit the following data:
Size of office floor=25mx25m
Size of panels=5mx5m
Loading class=4kN/m2
Materials: M20 grade concrete
Fe415 steel (AUC May/Jun-2013, 2012) (AUC Nov/Dec-2011)

2. Design an interior panel of a flat slab of size 5 m x5 m without providing drop and column head. Size of columns is 500x500 mm and live load on the panel is 4 kN/m^2. Take floor finishing load as 1 kN/m^2. Use M20 concrete and Fe 415 steel.

3. Design an interior panel of a flat slab with panel size 6x6 m supported by columns of size 500 x500 mm. Provide suitable drop. Take live load as 4 kN/m2. Use M20 concrete and Fe 415 steel.

4. Design the interior panel of the flat slab in problem 3, providing a suitable column head, if columns are of 500 mm diameter.

5. A flat slab system consists of 5 m * 6 m panels and is without drop and column head. It has to carry a live load of 4 kN/m^2 and a finishing load of 1 kN/m^2. It is to be designed using M20 grade concrete and Fe 415 steel. The size of the columns supporting the system is 500 x 500 mm and floor to floor height is 4.5 m. Calculate design moments in interior and exterior panels at column and middle strips in both directions.

UNIT III LIQUID STORAGE STRUCTURES

PART-A

1. Water is the types of reinforced concrete water tanks? (AUC May/Jun-2012) (AUC Nov/Dec-2011)

- Tanks resting on ground
- underground tanks
- Elevated water tanks.

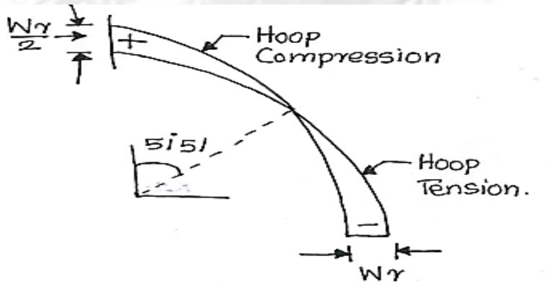
2. What are the forces acting on the dome? (AUC May/Jun-2013)

- Self-weight of the dome.
- Live load
- Floor finishing load

3. What are the conditions to be considered for the cylindrical tank situated underground? (AUC May/Jun-2013)

- When a water tank is built underground, the wall should be investigated for both internal water pressure and external earth pressure. The external pressure may be due to dry earth or due to a combination of earth and ground water.
- The design principles for such tanks are same as that for tanks resting on ground. In such case of tank built below ground with earth covering the roof will be a trapezoidal lateral pressure on the wall.

4. Sketch the variation of hoop stress between the crown and base of a hemispherical top cover dome carrying uniformly distributed load per unit surface area. (AUC Nov/Dec-2013)



Variation of Hoop Stress

5. Mention various critical load combinations that are to be considered in the analysis of walls of an underground rectangular water tank, when there is a possibility of ground water table to rise above the base slab. (AUC Nov/Dec-2013)

When there is a possibility of ground water table to rise above the base slab, not only walls are to be designed for saturated soil up to the extent of water above the base slab, but also the base slab is to be designed for the net uplift pressure of water.in addition check has to be applied for stability of the as a whole against uplift.

6. For what conditions the underground water tanks are designed and checked? (AUC May/Jun-2012) (AUC Nov/Dec-2011)

- The wall to be designed for both internal water pressure and external earth pressure.
- The external pressure may be due to dry earth or due to a combination of earth and ground water.
- The design principles for such tanks are same as that for tanks resting on ground. In such case of tank built below ground with earth covering the roof will be a trapezoidal lateral pressure on the wall.

7. Name the types of movement joints. (AUC Nov/Dec-2012)

- Construction joints
- Expansion joints
- Sliding joints

8. What theory is used to design? (AUC Nov/Dec-2012)

A. the members under direct tension

The members are designed by Dr.Reissners Method and Carpenter's Method.

B. the members under bending tension

The members are designed by I.S Code method.

9. 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.

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

- Strength
- Water tightness
- Overall stability

11. 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 up to 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.

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

13. Define the following terms:
Latitude
The circle of each ring in a dome is called Latitude.
Meridian circle
The circle drawn through two diametrically opposite points on a horizontal diameter and the crown is known as meridian circle.

14. 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.

15. Mention the thickness and steel requirement of dome.
- A minimum thickness of 7.5cm is provided to protect steel.
- Minimum steel requirements 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 longitudinally.

16. What are the three types of joints in water tank?
- Movement joints
- Construction joints
- Temporary open joints

17. What is the foundation specification for small capacity tanks?
- For small capacity tanks individual footings for columns can be provided. Infect, 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 leveling course.

18. What are the methods available for the analysis of circular tank?
- IS code method
- Reissners method
- Carpenter’s method
- Approximate method

19. 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 sides of the joints. All movement joints are essentially flexible.

20. What is contraction joint in water tanks?
A contraction joint is a typical movement joint which accommodates the contraction of the concrete.

21. 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.

22. 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.

23. What are conditions under which the walls of underground water tanks designed?
- Tank full with water, with no earth fill outside.
- Tank empty, with full earth pressure due to saturated earth fill.

24. What are the four components of design of underground water tanks?
- Design of long walls
- Design of short walls
- Design of base slab

25. What are two methods of analysis of rectangular tanks?
- Approximate analysis
- Exact analysis based on elastic theory

26. Where are the places domes are used?
- Roof of circular areas
- Circular tanks
- Exhibition halls, auditoriums and planetariums and
- Bottoms of tanks, bins and bunkers

PART-B

1) A reinforced concrete dome of 6m base diameter with a rise of 1.25m is to be designed for a water tank. The uniformly distributed load including finishes on come may be taken as 2kN/m2.adopting M20 concrete and grade I steel, design the dome and ring beam. Permissible tensile stress in steel=100N/mm2. (AUC May/Jun-2013) (AUC Nov/Dec-2012, 2013)

2) Design a circular tank with a flexible base for capacity of 500000 litres.The depth of water is to be 4m.Free board=200mm.use M20 concrete and grade I steel.Permissible direct tensile stress in concrete =1.2N/mm2.Permissible stress in steel in direct tension=100N/mm2.Sketch the details of reinforcements in tank walls. (AUC Nov/Dec-2012)

3) Design a circular water tank with fixed base for capacity of 400000 liters. The depth of water is to be 4m.free board=200mm.use M20 Grade concrete and grade I mild steel. Permissible direct tensile stress in concrete=1.2N/mm2

Permissible stress in steel in direct tension=100 N/mm2
Sketch the details of reinforcement in tank walls.

4) A rectangular R.C. water tank with an open top is store 80000litres of water. The inside dimensions of tank may be taken as 6mx4m.the tank rests on walls on all the four sides. Design the side the side walls of the tank using M20 concrete and grade I steel.

5) A reinforced concrete water tank resting on ground is 6mx2m with a maximum depth 2.5m.Using M20 concrete and grade I steel design the tank walls.

6) Design the side walls of a square of R.C.C. tank of capacity 70000 liters of water. Depth of water in the tank =2.8m.free board=0.2m.adopt M20 concrete and grade I steel. Tensile stresses in steel limited to 100N/mm2 at water face and 125N/mm2 away from face. Sketch the details of reinforcements in the walls of the tank.

7) Design an R.C. tank of internal dimensions 10mx3mx3m.the tank is to be provided underground. The soil surrounding the tank is likely to get wet. Angle of repose of soil in dry state is 300 and in wet state is 60. Adopt suitable working stresses. Soil weights 20kN/m3.adopt M20 concrete and grade I steel. (AUC May/Jun-2012, 13) (AUC Nov/Dec-2011)

8) Design an overhead flat bottomed R.C.C. cylindrical water tank to store 100kl of water. The top of the tank is covered with a dome. Height of staging=12m above ground level. Provide 2m depth of foundation. Intensity of wind pressure may be taken as 1.5kN/m2.adopting M20 grade concrete and Fe415 steel design the following:
Size of tank
Ring beam at junction of dome and side walls.
Side walls of tank
Bottom ring girder
Tank floor slab
Bracing at 4m intervals
R.C. column assuming six column supports
Foundation for the tank. (AUC May/Jun-2012) (AUC Nov/Dec-2011)

9) Explain the steps involved in the wind load analysis of elevated water tank.
(AUC Nov/Dec-2013)

UNIT IV INDUSTRIAL STRUCTURES

PART-A

1. Define effective length of a column. (NOV/DEC 11)

The effective length KL is calculated from the actual length L, of the member considering the rotational and relative translational boundary conditions at the ends. (Refer table 11 in IS 800-2007)

2. What are the different types of column base connections? (MAY/JUNE 12)

There are two types of column bases commonly used in practice: Slab base & Gusseted base

3. How does the code account for imperfections in a compression member?

(MAY/JUNE 12)

Common hot rolled and built up steel members used for carrying axial compression, usually fail by flexural buckling. The buckling strength of these members is affected by residual stresses, initial below and accidental eccentricities of load. To account for all these factors, the strength of member subjected to axial compression is defined by buckling class a, b, c, d are given in table 7 in IS-800:2007.

4. What do you mean by latticed column? (MAY/JUNE 12)

To achieve maximum value for minimum radius of gyration, without increasing the area of the section a number of elements are placed away from the principal axis using suitable lateral system. Rolled steel flats and angles are used for lacing. The lacing provided in a column the column is called latticed column.

5. What is the use of lug angle? (MAY/JUNE 12)

Lug angles connecting outstanding leg of a channel shaped member shall, as far as possible, be disposed symmetrically with respect to the section of the member.

6. What is meant by short strut?

If the strut is “short”, the applied forces will cause a compressive strain, which results in the shortening of the strut in the direction of the applied forces

7. What are the effect of strain hardening and the absence of clearly defined yield point?

If the material of the column shows strain hardening after a yield platen, the onset of first yield will not be affected, but the collapse load may be increased.

Designers tend to ignore the effect of strain hardening which in fact provides an additional margin of safety. High strength steels generally have stress-strain curves without a clear yield point.

At stresses above the limit of proportionality (fp), the material behaviour is non-linear and on unloading and reloading the material is linear-elastic. Most high strength structural steels have an ultimate stress beyond which the curve becomes more or less horizontal.

8. Write the effect of eccentricity of applied loading.

As has already been pointed out, it is impossible to ensure that the load is applied at the exact centroid of the column. The applied load (P) induces a bending moment (P.e) at every cross section.

This would cause the column to deflect laterally,in a manner similar to the initially deformed member discussed previously.

Once againthe greatest compressive stress will occur at the concave face of the column at a section midway along its length.

The load-deflection response for purely elastic andelastic-plastic behaviour is similar to those described in Fig. except that the deflection is zero at zero load.

9. What are the different effective lengths for different boundary condition?

Boundary conditions Theory Code value Both ends pin ended 1.0L 1.0L Both ends fixed 0.5L 0.65L One end fixed and the other end pinned 0.707L 0.8L One end fixed, and the other free to sway 1.2L 1.2L One end fixed and the other end free 2.0L 2.0L 17.

10. What is meant by flexural buckling and torsional –flexural buckling?

When the strut buckles by bending in a plane of symmetry of the cross section, referred to as “flexural buckling”. Singly symmetric or un-symmetric cross-sections may undergo combined twisting about the shear centre and a translation of the shear centre. This is known as “torsional – flexural buckling”.

11. What are Steps in the design of axially loaded columns?

The procedure for the design of an axially compressed column is as follows:

(i) Assume a suitable trial section and classify the section in accordance with the classification in chapter.

(ii) Arrive at the effective length of the column by suitably considering the end conditions.
(iii) Calculate the slenderness ratios (λ values) in both minor and major axes direction

(iv) Calculate fcd values along both major and minor axes

(v) Compute the load that the compression member can resist (pd=Acfcd)

12. Write about batten plate’s compression member.

When compression members are required for large structures like bridges, it willbe necessary to use built-up sections. They are particularly useful when loads are heavy and members are long (e.g. top chords of Bridge Trusses).

Built up sections are popular in India when heavy loads are encountered. The cross section consists of two channel sections connected on their open sides with some type of lacing or latticing (dotted lines) to hold the parts togetherand ensure that they act together as one unit.

The ends of these members areconnected with “batten plates” which tie the ends together.

13. What are the three classifications for determination of size of plate?

Class I- will pertain to all base plates the moment on which is so small in proportion to the direct load that there is compression over the entire area between the bottom of the base and its foundation .

Class II- will pertain a comparatively small range of base plates which have tension over a small portion - one - third or loss of the area.

Class III- will include those which are exposed to a comparatively large moment and which therefore have tension over a large portion - more than one -third of the area between the bottom of the base plate and its concrete footing.

PART-B

1) A roof truss shed is to be built in Lucknow for an industry. The size of shed is 24 m × 40 m. The height of building is 12 m at the eves. Determine the basic wind pressure.

2) A power plant structure having maximum dimension more than 60 m is proposed to be built on down hill side near Dehradun. The height of the hill is 400 m with a slope of 1 in 3. If the location is 250 m from the crest of the hill on downward slope, and its eve board is at a height of 9 m, determine the design wind pressure.

3) Determine the design loads on the purlins of an industrial building near Visakhapatnam, Given:
Class of building: General with life of 50 years.
Terrain: Category 2.
Maximum dimension: 40 m.
Width of building: 15 m.
Height at eve level: 8 m.
Topography: θ less than 3°.
Permeability: Medium
Span of truss: 15 m
Pitch:
Sheeting: A.C. sheets.
Spacing of purlins: 1.35 m.
Spacing of trusses: 4 m.

4) Design a truss of span 15 m, spacing 4 m to be built near Visakhapatnam, other details being same as given in Problem 3.

5) A 4 m high column in a building has to transfer a factored load of 400 kN transferred by a beam at an eccentricity of 100 mm from the major axis of the section. Assuming top end is hinged and bottom end is fixed, design the column.

UNIT V GIRDERS AND CONNECTIONS

PART-A

1. **What is laterally unsupported beam? Give an example.** (NOV/DEC 11)

   Beams with major axis bending and compression flange not restrained against lateral bending fail by lateral tensional buckling before attaining their bending strength. The effect of lateral tensional buckling need not be considered in the design of beams. These types of beams are called laterally unsupported beams.

2. **What is a plate girder? Where is it used?** (NOV/DEC 11)

   When span and load increase, the available rolled section may not be sufficient, even after strengthening with cover plates. Such situations are common in the following:

   Larger columns free halls are required in the lower floor of a multistory building. In a workshop, where girders are required to carry crane beams In road or railway bridges

   In such situations one of the remedies is to go for a built up I section with two flange plates connected to a web plate of required depth. The depth of such I beams may vary from 1.5m to 5.0m. This type of I beams are known as plate girder.

3. **Where are bearing stiffeners used?** (MAY/JUNE 12)

   In case of rolled steel sections, the webs are so proportioned that it will safely carry load without buckling or crippling of the web.

   But in plate girders to achieve economy, webs are made thin. In such case the stiffeners are required at the ends to transfer the reaction safety.

   Stiffeners may be required if the concentrated load are acting at some points in the girder. The stiffeners which transfer the load are known as bearing stiffeners.

4. What do you understand by panel buckling? (MAY/JUNE 12)

The panels of the beam sections are failed by the buckling effect. This type of buckling is called as a panel buckling. The web buckling and the panel buckling are same as in the failure mode but the panels are failing by the method buckling.

5. What do you mean by web buckling? (MAY/JUNE 12)

The web in a rolled steel section behaves like a column when placed under concentrated loads. The web is quite thin and is, therefore subjected to buckling.web buckling occurs when the intensity of vertical compressive stress near the centre of section becomes greater than the critical buckling stress for the web acting as column.

6. What do you mean by castellated beam? (MAY/JUNE 12)

Loads and reactions concentrated along a short length of flange of beam are raised by compressive stresses in the web which vary with distance from the load.

The webs of rolled steel sections are, therefore subjected to a large amount of stresses just below the concentrated loads and above the reactions from the support. Stress concentration occurs at the junction of the web and flange.

As a result, large bearing stresses are developed below the concentrated loads. Consequently, the web near the portion of the stress concentration tends to fold over the flange. This type of buckling is called web crippling.

7. Write short notes on built up beams.

The built up beams are also termed as compound beams or compound girders. The built up beam when the span, load and corresponding bending moment are of such magnitudes that rolled steel beam inadequate to provide required section modulus. The built up beams are also used when rolled section inadequate for limited depth.

8. What are the classifications of cross sections?

Class I (plastic)

Class 2 (Compact)

Class 3 (semi compact)

Class 4 (slender)

9. What is the design procedure for design of beams?

A trial section is assumed it is going to be a plastic section Then it is checked for the class it belongs Check for bending strength Check for shear strength Check for the deflection

10. What is meant by limit state design?

Designs should ensure that the structure does not become unfit for the use for which it is required. The state at which the unfitness occurs is called a limit state.

11. What are special features of limit state design method?

• It is possible to take into account a number of limit states depending upon the Particular instance

• This method is more general in comparison to the working stress method. In This method, different safety factors can be applied to different limit states, which is more rational than applying one common factor (load factor) as in the plastic design method.

• This concept of design is appropriate for the design of structures since any new knowledge of the structural behavior, loading and materials can be readily incorporated.

12. Explain the behavior of steel beams?

Laterally stable steel beams can fail only by (a) Flexure (b) Shear or (c) Bearing, Assuming the local buckling of slender components does not occur. These three conditions are the criteria for limit state design of steel beams. Steel beams would also become unserviceable due to excessive deflection and this is classified as a limit state of serviceability. The factored design moment, M at any section, in a beam due to external actions Shall satisfy M < Md Where Md= design bending strength

13. Write Short notes on compact sections

When the lateral support to the compression flange is adequate, the lateral buckling of the beam is prevented and the section flexural strength of the beam can be developed.

The strength of I-sections depends upon the width to thickness ratio of the compression flange. When the width to thickness ratio is sufficiently small, the beam can be fully plastified and reach the plastic moment, such section are classified as compact sections.

14. What is meant by slenderness sections?

When the width to thickness ratio of the compression flange is sufficiently large, local buckling of compression flange may occur even before extreme fibre yields. Such sections are referred to as slender sections.

15. Write short notes on shear lag effects?

The simple theory of bending is based on the assumption that plane sections remain plane after bending. But, the presence of shear strains causes the section to warp. Its effect in the flanges is to modify the bending stresses obtained by the simple theory, producing higher stresses near the junction of a web and lower stresses at points away from it .This effect is called ‘shear lag’.

This effect is minimal in rolled sections, which have narrow and thick flanges and more pronounced in plate girders or box sections having wide thin flanges when they are subjected to high shear forces, especially in the vicinity of concentrated loads

16. List the various factors affecting the lateral-tensional buckling strength .

Distance between lateral supports to the compression flange.

• Restraints at the ends and at intermediate support locations

• Type and position of the loads.

• Moment gradient along the length.

• Type of cross-section.

17. How do you improve the shear resistance in plate girder?

i. Increasing in buckling resistance due to reduced c/d ratio;

ii. The web develops tension field action and this resists considerably larger Stress than the elastic critical strength of web in shear

18. What are the classifications in Stiffeners?

a) Intermediate transverse web stiffeners

b) Load carrying stiffeners

c) Bearing stiffeners

d) Torsion stiffeners

e) Diagonal stiffeners and

f) Tension stiffeners

19. Write about the Box girders.

- The design and detailing of box girders shall be such as to give full advantage of its higher load carrying capacity.
- Diaphragm shall be used where external vertical as well as transverse forces are to be transmitted from one member to another.
- The diaphragms and their fastenings shall be proportioned to distribute other force applied to them and in addition, to resist the design transverse force and the resulting shear forces.
- The design transverse force shall be taken as shared equally between the diaphragms.

20. Write Short notes on Purlin and sheeting rails .

Purlins attached to the compression flange of a main member would normally be acceptable as providing full tensional restraint; where purlins are attached to tension flange, they should be capable of providing positional restraint to that flange but are unlikely (due to the rather light purlin/rafter connections normally employed) to be capable of preventing twist and bending moment based on the lateral instability of the compression flange.

21. Write the Special features of limit state design method?

• Serviceability and the ultimate limit state design of steel structural systems and their components.

• Due importance has been provided to all probable and possible design conditions that could cause failure or make the structure unfit for its intended

• The basis for design is entirely dependent on actual behaviour of materials in structures and the performance of real structures, established by tests and long-term observations

• The main intention is to adopt probability theory and related statistical methods in the design.

• It is possible to take into account a number of limit states depending upon the particular instance

PART-B

1) Determine the uniformly distributed load carrying capacity of the welded plate girder shown in fig. When it is used as a cantilever beam of 4m effective span and checks it for shear, deflection, web buckling and web crippling. Assuming stiff bearing length as 100mm.

2) Design a welded plate girder of span 30m to carry on superimposed load of 35kN/m. avoid use of bearing and intermediate stiffeners. Use Fe415 steel

3) Design a simply supported gantry girder to carry one electric overhead travelling crane, given Span of the gantry crane=6.5m Span of the crane girder=16m Crane capacity=250kN Self weight of crane excluding trolley=280 kN Self weight of the trolley=50 kN Minimum hook approach=1.0m Distance between wheels=3.5m Self weight of rails=0.3 kN/m

4) An ISLB 300 carrying udl of 50 kN/m has effective span of 8 m. This is to be connected to the web of girder ISMB 450. Design the framed connection using 20 mm black bolts.

5) An ISMB 450 is to be connected to the flange of a column ISHB 300 @ 618 N/m. The end reaction transmitted by the beam is 120 kN. Design an unstiffened seated connection. Use M20 black bolts.

6) An ISMB 500 beam transmits an end reaction of 250 kN to the web of a column ISHB 300 @ 577 N/m. Design and sketch a stiffened seated connection. Use M24 black bolts.

7) A beam ISMB 300 transmits an end shear of 120 kN and a moment of 20 kN-m to the flange of a column ISHB 300 @ 577 N/m. Using 20 mm dia shop bolts design suitable end connection.

8) Design a bracket connection to connect a beam ISLB 500 to a column ISHB 400 @ 806 N/m, if vertical shear and moment to be transmitted are 120 kN and 130 kN-m respectively. Use M24 bolts at a pitch of 75 mm. Provide edge distance of 50 mm for all connections.