SHRI ANGALAMMAN COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF CIVIL ENGINEEING

CE-1302 DESIGN OF REINFORCED CONCRETE ELEMENTS

UNIT I- METHODS OF DESIGN OF CONCRETE STRUCTURES

PART-A

1. What are the expressions recommended by the IS 456-2000 for modulus of Elasticity and flexural strength?
2. Write the formula for the neutral axis depth factor "K" in working stress design.
3. How limit state method aims for a comprehensive and rational solution to the design problem?
4. What do you understand by characteristic strength of materials?
5. Write any four assumptions in the analysis and design of reinforced concrete structures.
6. Draw the transformed section of a singly reinforced RC beam in the uncracked stage.
7. How limit state method differs from working stress method.
8. Define "Limit state"
9. Write short notes on actual and idealized stress strain curve for concrete and steel.
10. Explain principles of working stress method.
11. Explain principles of ultimate load method
12. Explain principles of limit state method of design.
13. What is meant by cracked section?.
14. What do you mean by moment of resistance of the section?
15. Define characteristic strength of materials.

PART – B

1. A RC beam of rectangular section 300 mm wide and 650 mm overall depth is reinforced with 4 bars of 32mm diameter. Effective cover of 50mm.Estimate the moment of resistance of the section using working stress method

2. Discuss briefly the calculation of permissible stresses in liquid retaining structures and sketch the reinforcement details in various types of junctions of tank wall and base slab.

3. Derive the expressions for the depth of neutral axis and moment of resistance of a rectangular singly reinforced balanced section under flexure and obtain the design constants K,J and Q for M20 grade of concrete and Fe415 steel. Use working stress method.

4. A reinforced concrete rectangular section 300mmwide and 600mm over all depth is reinforced with four bars of 25mm diameter with an effective cover of 50mm on the tension side. The beam is designed with M20 grade of concrete and Fe415 steel. Determine the allowable bending moment and the stresses developed in steel and concrete under this moment. Use working stress method.

5. Define the following:
   (i) Characteristic strength of materials
   (ii) Characteristic loads
   (iii) Partially safety factors and design values

6. Write down the design procedure for liquid retaining structure for the members subjected to axial tension and bending moment .

7. A singly reinforced beam is of effective section 450mm x 715mm. It is reinforced with 8 nos. of 20mm diameter Fe250 bars. Calculate moment of resistance if M20 grade of concrete is used by working stress method.

8. Design the reinforcement required for a T – beam with flange width 1500mm,rib width 300mm,thickness of flange 100mm,effective depth o 735mm to carry a moment of 380 KN.M. Use working stress method. Use M20 grade of concrete and Fe415 steel.

9. (i) Differentiate between working stress method and limit state method.

   (ii) Explain the following term:
      1. Characteristic strength and characteristic loads.
      2. Partial safety factors
      3. Balanced section and under reinforced section.

10. A singly reinforced beam 250mm x 500mm in section is reinforced with four bars of 16mm diameter with an effective cover of 50mm.Effective span of the beam is 6m. use M20 grade of concrete and Fe415 steel.Determine the the central concentrated load that can be carried by the beam in addition to its self weight.

11. A doubly reinforced beam 300mm x 600mm overall depth is reinforced with 3bars of 36 mm dia at an effective depth of 550 mm. The section in section is reinforced with four bars of 16mm diameter with an effective cover of 50mm.Effective span of the beam is 6m. use M20 grade of concrete and Fe415 steel. Calculate the moment of Resistant this section.

UNIT II- **LIMIT STATE DESIGN FOR FLEXURE**

PART-A

1. Distinguish between unde reinforced and over reinforced sections.
2. Sketch the edge and middle strips of a two way slab.
3. Under what circumstances are doubly reinforced beams resorted to?
4. Why is secondary reinforcement provided in one way RC slab?.
5. Define one way slab?
6. Define two way slab?
7. Write the formula for maximum moments per unit width in two way slab.
8. List the types of slab.
9. Define characteristic strength of materials.
10. What are the various collapses consider in limit state design?
11. Write the formula for effective flange width of isolated L- beam.
12. Draw the reinforcement details for a T-Beam.
13. Under what circumstances T-Beams are used?
14. Differentiate between 'one way slab' and 'two way slab'.
15. Draw the reinforcement details for slab.

PART - B

1. Design a two way slab for an office floor to suit the following data:
   Live load = 120KN / m^2.
   Load due to finishes = 1.50 KN / m^2.
   Size of floor = 4m x 6m
   Edge conditions: Two adjacent edges discontinuous.

2. Design a singly reinforced concrete beam of clear span 5 m to support characteristic live load of 10 KN/m .Check the adequacy of the section shear. Take beam width = 200mm.

3. Analysis a T-Beam section of 250mm width of web,1200mm width of flange,100mm thickness flange and 450mm effective depth to determine the ultimate moment of resistance of for the two cases of reinforcements.
   (i) 4 Nos of 20mm diameter.
   (ii) 4 Nos of 25mm diameter.
   Consider M20 grade of concrete and Fe415 steel.

4. Design a two way slab panel for the following data:

Live load = 4 KN / m^2 .
Load due to finishes = 1 KN / m^2 .
Size = 7m x 5m
Width of support = 300mm
Edge conditions = Two short edges discontinuous.
Consider M20 grade of concrete and Fe415 steel.

5. Design a simply supported RCC slab for an office floor having clear dimensions of 4m x 6m with 230mm walls all-round..Assume live load as 4 KN / m^2.use M20 grade of concrete and Fe415 steel.

6. A flanged beam with flange width 960mm,rib width 200mm,thickness of flange 125mm,overall depth of beam 375mm and effective depth 315mm,is to support a factored moment of 240 KN.M. Determine the moment of resistance and also the amount of reinforcement. use M20 grade of concrete and Fe415 steel. **(December 2009)**

7. Design a rectangular beam of cross section 230 x 600mm and of effective span 6m.Imposed load on the beam is 40 KN /M. use M20 grade of concrete and Fe415 steel.

8. A hall has clear dimensions 3m x 9m with thickness of wall support is 230mm the live load on the slab is 3 KN / m^2 and finishing load of 1 KN / m^2 .use M20 grade of concrete and Fe415 steel, design the slab.

9. A T-beam has web width 200mm,flange width 750mm slab thickness 100mm and total depth 550mm with effective cover of 50mm . Use M20 grade of concrete and Fe415 steel. adopting limit state method, calculate area of steel required to carry a moment of 450 KN.M.

10. Design a simply supported slab for a hall of size 4m x 10m clear dimensions. The thickness of wall support is 230mm.Assume live load as 4 KN / m^2 and finish as 1 KN / M^2.Use M25 grade of concrete and Fe415 steel.

UNIT III- **LIMIT STATE DESIGN FOR BOND, ANCHORAGE SHEAR AND TORSION**

PART-A

1. What are the types of reinforcements used to resist shear force?
2. What do you understand by development length of a bar?
3. What is the IS code provision for maximum spacing of vertical stirrups in RC beams?.
4. Distinguish between flexural bond and development bond.
5. Sketch the various types of shear reinforcement normally provided in practice.
6. Explain the various types of shear failures.
7. Explain the various types of shear design of RCC beams.
8. Explain the reasons for the development of diagonal tension cracks in RC beams
9. Define Shear.
10. Define Bond stress.
11. Why is minimum shear reinforcement necessary in beams?
12. What is meant by 'development length of bar'?
13. Why is secondary reinforcement provided in one way slab?
14. List the types of shear reinforcement.
15. Draw the types of shear reinforcement.

PART – B

1. A RCC section 200mm x 400mm is subjected to the following factored forces:Torsional moment of 2.50 KN.m and a transverse shear of 60 KN. use M25 grade of concrete and Fe415 steel.Determine the reinforcements required using following data: overall depth:400mm,effective depth:350mm,b1=150mm,d1=300mm.

2. A simply supported beam of 8m span is reinforced with 6 bars of 25mm diameter at center of span and 50 percent of the bars are continued into supports.Check the development length at supports.The beam supports a characteristic total load of 50KN/m.

3. A rectangular beam of 300 mm wide and 500mm effective depth is reinforced with five bars of 20mm diameter bars on the tension side.If two bars are bentup at 45 degrees near supports check adequacy of the section for shear under an ultimate shear force of 300KN and design the shear reinforcement if necessary . Consider M20 grade of concrete and Fe415 steel.

4. Design a rectangular beam section of 250mm width and 500mm over all depth subjected to the ultimate values of bending moment of 40 KN.M ,shear force of 40

KN , Torsional moment of 30 KN.M. Adopt of an effective cover of 50mm on top and bottom. use M20 grade of concrete and Fe415 steel.

5. The simply supported beam on two masonry wall 230mm thick and 6m apart(center to center) . The beam has to carry , in addition to its own weight , a distributed live load of 10 KN/M . and a dead load of 5 KN/M , provide with web reinforcements of 8mm plain bar U-stirrups at uniform spacing of 200mm. Check the adequacy of the shear design . If necessary ,revise the design.

6. A reinforced concrete cantilever beam of rectangular section 300mm wide and 600mm deep is into a column 500mm wide. The cantilever beam subjected to a hogging moment of 200 KN.M. at the function of beam and check for the required anchorage length . use M20 grade of concrete and Fe415 steel.

7. (i) Explain the various types of shear failures and shear design in RC beams.
   (ii) Explain how the torsional moment is taken care in the design of beams.
   (iii) Differentiate between flexural bond and development bond.

8. A RC beam 250 mm wide and 550 mm deep RC beam is reinforced with 4 bars of 25mm diameter. effective cover of 50mm.It is provided with 2 legged 8mm diameter stirrups at a spacing of 150mm. Determine the strength of the section.
   If two bars are bentup at 45 degree at a section,what is the strength of the section in shear?

9. A RC rectangular beam 350mm x 550mm effective section has a factored shear of 400 KN at a section. The tension steel consist of 4-32 mm diameter bars.Design the shear reinforcement required. use M25 grade of concrete and Fe415 steel.

10. A ‘T’ beam having flange size 700mm x 120mm and web size 350mm x 680mm is subjected to factored bending moment of 215 KN.m ,factored shear force of 150 KN. And a factored twisting moment of 105 KN.m . Design the required reinforcements.Assume Percentage of tension steel as 0.72. use M30 grade of concrete and Fe415 steel.

UNIT IV- **LIMIT STATE DESIGN OF COLUMNS**

PART-A

1. What are the braced columns?
2. State the methods recommended by the IS 456 to estimate the effective length of columns.
3. Write the effects of moments influencing the load carrying capacity eccentrically loaded long columns.
4. Write any two functions of lateral ties in a RC column.
5. Define column.
6. Classification of column.
7. Define slenderness ratio.
8. Write down the formula for minimum eccentriccities in columns.
9. Define long column.
10. What are the types of loading on columns?
11. What is meant by braced columns?
12. Calculate minimum eccentricity for a column of size 600mm x 450mm,having unsupported length 3m.
13. Define short column
14. What is meant by short and long colums?
15. Define uni axial bending.

PART - B

1. Design the required reinforcements in a column of 400mm x 600mm size subjected to a characteristic axial load of 2000 KN.The column has an unsupported length of 3m and is braced against the side sway in both directions.

2. A short column located at the corner of a multistoried building is subjected to an axial factored load of 2000KN together with factored moment of 75 KN.M and 60 KN.M acting in perpendicular planes.The size of the column is 450mm x 450mm .Design suitable reinforcements in the column section.

3. Determine the ultimate load carrying capacity of a circular column section of 500mm diameter reinforced with 8 bars of 28mm diameter adequacy tied with lateral ties . use M25 grade of concrete and Fe415 steel.

4. A rectangular column of effective height 4m is subjected to a characteristic load of 800KN and bending moment of 100 KN.M about major axis of the column. Design a suitable section for the column so that the width should not exceed 400mm. use M25 grade of concrete and Fe415 steel.

5. Design a short circular column of diameter 400mm supported a factored axial load of 900 KN, together with a factored moment of 100 KN.M. Use M20 grade of concrete and Fe415 steel.

6. Design the reinforcement in a short column 400mm x 600mm subjected to an ultimate axial load of 1600 KN together with ultimate moment of 120 KN.M and 90 KN.M about major and minor axis respectively. Use M20 grade of concrete and Fe415 steel.

7. (i) What are rhe assumptions made in limit state of collapse – compression?Discuss.
   (ii) Design a column 4 m long restrained in position and direction at both ends to carry an axial load of 1600KN.

8. A column of size 300 mm x 400 mm has effective length of 3.60m and is subjected to factored axial load of 1100 KN and factored moment of 150 KN.M about the major axis.Design the column. use M25 grade of concrete and Fe415 steel.Provide the reinforcement in (Assume cover as 60mm)
   (i)Two sides only and
   (ii)All the four sides

9. A column 300mm x 400mm has an unsupported length of 3m and effective length of 3.60m .It is subjected to Pu = 1100 KN and Mu = 230 KN.m about the major axis .Design the column. use M25 grade of concrete and Fe415 steel. Take d' = 60m

10. A RC braced column 300mm x 500mm with unsupported length 9m,effective length 6.75m has My (top) = 70 KN.M and My (bottom) = 10KN.M as ultimate moments.Axial load an column Pu = 1700KN .If the column is bent is double curvature, determine the design moments.

UNIT V- **LIMIT STATE DESIGN OF FOOTING AND DETAILING**

PART-A

1. What is punching shear in a RCC footing?
2. Sketch the reinforcement detailing for a cantilever slab.
3. What are the situations in which combined footing are prefered to isolated footings?
4. What is SP 34?
5. Define footing
6. What are the various types of footing?
7. Define isolated footing.
8. What is the minimum depth of footing according to rankine's theory?
9. Define combined footing.
10. Where shear occurs in footing?
11. Define punching shear.
12. Give some eaamples for structurals elements,which will be subjected to torsional moment.
13. When do you go for combined footing?
14. Sketch one way shear and two way shear in footing.
15. When will you use plain concrete footing?

PART – B

1. A RCC column 400mm x 400mm supports an axial service load of 1000KN.The Safe bearing capacity of soil is 200 KN / m^2 .Design suitable footing for the column and sketch the reinforcement details.

2. Write brief technical note:
   (i)Design of eccentrically loaded footing.
   (ii)Design of wall footing.

3. A rectangular RCC column of size 300mm x 450mm carrying an axial load of 1500KN. If the Safe bearing capacity of soil is 120 KN / m^2 design a suitable footing use M25 grade of concrete and Fe415 steel.

4. With the help of neat sketches explain the standard method of detailing for

   (i) A two span continuous beam of T section the main bars for positive and negative B.M shear stirrups etc.
   (ii) A circular column indicating longitudinal bars with helical reinforcements.

5. Design a square spread footing to carry a column load of 100 KN from a 40cm square tied column containing 20mm bars as the longitudinal steel. The bearing capacity of soil is 100 KN / m^2.Consider base of footing at 1m below the ground level .The unit weight of earth is 20 KN / m^3 .Use M20 grade of concrete and load factor = 1.50.

6. Design a combined footing with strap beam for two reinforced concrete column of size 300mm x 300mm spaced 4m center to center, and each supporting a service load of 500 KN . The safe bearing capacity of soil at site is 150 KN /m. Use M20 grade of concrete and Fe415 steel.

7. (i)What are the objectives of structural drawing? Exlain.

   (ii)What is meant by structural ductility? What are the measures taken for improving the ductility of RC structures?

8. Design a RCC footing for a short axially loaded column of size 300mm x 300mm carrying load 600KN.Safe bearing capacity of soil is 180KN / m^2 .also sketch the details of the reinforcement

9. Design a rectangular footing for 500mm x 350mm column to transmit load of 1000KN.Safe bearing capacity of soil is 120KN / m^2 . use M20 grade of concrete and Fe415 steel.

10. Design a square footing for a circular column 500mm in diameter to carry a load of 1500KN. The Safe bearing capacity of soil is 200 KN / m^2 . use M20 grade of concrete and Fe415 steel.