DESIGN OF RC ELEMENTS

UNIT-1

PART-A

1. Calculate the design strength for M 30 grade concrete and Fe 415 grade steel?
2. What is the important principle of ultimate load method?
3. Write the classification of structures according to crack width?
4. How is limit state method differ from working stress method?
5. Distinguish between characteristic load and factored load?
6. What is the importance of flanged beams?
7. What is the main advantage of limit state of collapse?
8. How is the safety margins assigned in Elastic method and ultimate load method?
9. Calculate the limiting value of tensile stress in a cracked section of a flexural member made with M25 grade of concrete.
10. What are the advantages of liimiitt state method overworking stress and ultimate load methods?
11. How do you find the moment of resistance of a beam section??
12. What is modular ratio? Determine the modular ratio at M20 & M25grade concrete?
13. What do you understand by limit state of collapse??
14. Draw stress--strain curve for various grades of ssteel..
15. State the assumtions made in working stress method.?

PART-B

1.a) Explain clearly under-reinforced, balanced and over-reinforced sections?

b) What do you mean by uncracked and cracked sections and how will you determine the moment of resistance of these section?

2. A R.C. beam of rectangular cross section is required to resist a bending moment of 120 kN-m at Service State. Design the suitable dimensions of the cross section and reinforcement for the balanced sections. Take the effective depth as twice the width. Assume M 20 grade concrete and Fe 415 grade steel. Adopt working stress method?

3.a) Explain the concept of elastic method?

b) What do you mean by uncracked and cracked sections and how will you determine the moment of resistance of these section?

4. A R.C. beam of rectangular cross section is required to resist a bending moment of 120 kN-m at Service State. Design the suitable dimensions of the cross section and reinforcement for the balanced sections. Take the effective depth as twice the width. Assume M 20 grade concrete and Fe 415 grade steel. Adopt working stress method?

5. A reinforcement concrete beam section of size 300x700 mm effective depth is reinforced with 3 bars of 20 mm diameter in tension. Determine the moment of resistance and the maximum stresses induced in the materials using working stress method?

6. Design a circular water tank of capacity 200 kilolitres resting on ground and flexible base at the bottom.Assume allowable stess as □=1.2MPa.□=115 MPa and modular ratio m=13.

7. Design a rectangular RC beam in flexure and shear when it is simply supported on masonry walls 300mm thick and 5m apart (centre to centre) to support a distributed live load of 8 KN/m and a dead load of 6KN/m in addition to its own weight. Materials used are M20 grade of concrete and Fe415 steel bars. Adopt working stress method of design.

8. Design the roof slab for a Hall of size 4m x 10m by working stress method using M20 concrete and Fe415 steel. The slab is simply resting on 230mm thick brick walls all around. Take the live load on the slab as 1.5KN/m^2 and finish load as 2.25KN/m^2.

9. Design a doubly reinforced beam to carry a super imposed load of 60KN/m. The overall depth and width of the beam are restricted to 840mm and 300mm respectively. The beam has a clear span of 5m and bearing of 50cm on each end. Use M_{15} grade concrete and M.S. grade-I bars.

10. The floor of hall measure 16m x 16m to the faces of the supporting walls. The floor consists of three beams spaced at 4m centre to centre, and the slab thickness is 120mm. The floor carries an udl of 5KN/m^2, inclusive of the floor finishes. Design the intermediate beam. Use M_{15} and M.S. grades. Design the section. Take width support=500mm.

DESIGN OF RC ELEMENTS

UNIT-2

PART-A

1. Mention the codal provisions for minimum reinforcement to be provided as primary and secondary reinforcement to be provided as primary and secondary reinforcement in R.C. slab?
2. Compute the area of reinforcement required for a balanced section of width 200 mm and effective design 425 mm as per limit state design. Use M 25 grade concrete and Fe 415 grade steel. Use design aids.
3. Enumerate the codal provisions for minimum reinforcement to be provided as primary and secondary reinforcement in R.C. slab.
4. What is the importance of flanged beams?
5. State the basic assumptions used in theory of simple bending as applied to LSD of RC structures
6. Distinguish between balanced section and under reinforced sections?

7. Distinguish between one –way and two way slabs.

8. Discuss the different limit state to be considered in reinforced concrete design?

9. Why is it necessary to provide transverse reinforcement in a one way slab?

10. What are the three basic methods using factor of safety to achieve safe workable structures?

11. Explain maximum depth of neutral axis?

12. Find the depth of neutral axis in terms of ‘d’ for a balanced section using Fe 415 steel, in limits method?

13. What is the difference in the design of one way slab and two way slabs?

14. Distinguish between under reinforcement and over reinforcement section?

15. Sketch edge and middle strips of a two way slab?

15. How Limit State Method aims for a comprehensive and rational solution to the design problem?

16. Differentiate between WSD and LSD.

PART-B

1.a) With a neat sketch, write the values of moment and shear coefficients of continuous slab?

b) Design a simply supported R.C. slab for a roof of a hall 4.5 mx10 m (inside dimension with 230 mm walls all around). Assume a live load of 4.5 kN/m^2 and a floor finish of 1 kN/m^2. Adopt limit state design. Use M 20 grade concrete and mild steel

2. Determine the depth of neutral axis and ultimate moment of resistance of T beam section for the following data:

Flange width = 800 mm, Flange thickness = 150 mm, Web width = 300 mm. Effective depth = 420 mm. Area of tension reinforcement = 14701 mm^2. Assume = M 25 grade concrete and Fe 415 grade steel.

3. Design a R.C. slab for a room having inside dimensions 3 m x 6 m. The thickness of supporting wall is 300 mm. The slab carries 100 mm thick lime concrete at its top, the unit weight whichmay be taken as 19kN/m^3. The live load on the slab may be taken as 2.5 kN/m^2. Assume the slab to the simply supported at the ends. Use M 15 grade concrete and MS grade steel.

4. Design a doubly reinforced beam to carry a super-imposed load of 60kN/m. The overall depth and width of the beam are restricted to 840 mm and 300 mm respectively. The beam has a clear span of 5 m and a bearing of 50 cm on each end. Take □abc=5 N/mm^2, □st=140 N/mm^2 and m=18. Draw the reinforcement details.

5. A rectangular beam is to be simply supported on supports of 230 mm width. The clear span of the beam is 6 m. The beam is to have a width of 300 mm, the characteristic superimposed load is 12 kN/m. Design the beam and sketch the reinforcement details.

6. Design a RC slab for a room of clear dimensions 4 m x 5 m. The slab is simply supported all around on the walls of width 300 mm. The slab has to carry a live load of 4 kN/m^2 and floor finish load of 1 kN/m^2. Assume the corners are held down.

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UNIT-3

PART-A

1. Write down the value of design bond stress for M 30 grade concrete?

2. What do you mean by primary and secondary torsion?

3. Define band and anchorage?

4. What do you mean by primary and secondary torsion?

5. Sketch the various types of shear reinforcements normally provided in practice?

6. What is equivalent shear as specified in IS456 for members subjected to torsion and shear?

1. What are the types of reinforcements used to resist shear?
2. Explain the difference between primary and secondary torsion. Give two examples each?
3. Under what circumstances are doubly reinforced beams used?
4. Reinforced concrete slab are generally safe in shear and do not require shear reinforcement? Why?
5. Mention the difference in design principles for L Beam and T Beam?
6. When shear reinforcement is necessary in a beam?
7. What is bond stress? Write an expression for it?
8. What are the types of reinforcement used to resit shear force?
9. What you understand by development length of bar?
10. Differentiate between flexural bond and development bond.
11. What will be minimum and maximum area of tension reinforcement in a beam?
12. How shear reinforcement improves the strength of beam?

PART-B

1.(a) (1) Distinguish between theoretical and physical cut-off points.

(2) A simply supported beam is 6m in span and carries a characteristic load of 60kN/m. If six numbers of 20 mm diameter bars are provided at the mid span and four numbers of these bars are continous into the supports, check the development length at the supports. Adopt M 20 grade concrete and Fe 415 grade steel.

(b) A beam of rectangular section 300 mm width and 500 mm effective depth, is subjected to factored moment of 175 kN-m, factored shear force of 25 kN and factored twisting moment of 10 kN-m. Determine the area of reinforcement to resist the above forces. Use M20 grade concrete and Fe 415 grade steel.

2.(a) (1) Distinguish between theoretical and physical cut-off points.

(2) A simply supported beam is 6.20m in 3 pan and carries a characteristic load of 62kN/m. If six numbers of 20 mm diameter bars are provided at the mid span and four numbers of these bars are continous into the supports, check the development length at the supports. Adopt M 20 grade concrete and Fe 415 grade steel.

(b) A beam of rectangular section 300 mm width and 500 mm effective depth, is subjected to factored moment of 180 kN-m, factored shear force of 30 kN and factored twisting moment of 15 kN-m. Determine the area of reinforcement to resist the above forces. Use M20 grade concrete and Fe 415 grade steel

3.(a) A RC beam of rectangular section 300 mmX 550 mm is reinforced with 6 bars of 20 mm diameter place at an effective cover of 50mm. Out of 6 bars 3 bars have been bent up 45°. Design the shear reinforcement if the beam is subjected to a UDL of 100 kN/m over simply supported clear span of 7 m.

(b) Design a rectangular RC beam section to carry a factored bending moment of 200 kNm, factored shear force of 120 kN and a factored torsional moment of 75 kNm.

UNIT - 4

PART-A

1. Distinguish between braced and unbraced columns.
2. Name any two methods used for design of long columns.
3. Enumerate compression members with helical reinforcement.
4. Write the basic assumption for the combined axial load and uniaxial bending on columns
5. Write any two code requirements on slenderness limits.
6. Define member stability effect in braced columns.
7. Enumerate the functions of the transverse reinforcements in a reinforced concrete column.
8. When you provide eccentrically loaded columns?
9. Enumerate the function of the traverse reinforcements in a reinforced concrete column.
10. When do you provide eccentrically loaded columns?
11. Write any two code requirements on slenderness limits.
12. Define member stability effect in braced columns.
13. Enumerate compression members with helical reinforcement.
14. Write the basic assumption for the combined axial load and uniaxial bending on columns.
15. Distinguish between braced and unbraced columns.
16. Name any two methods used for design of long column

17. How do you classify a column as short or long?
18. Write the procedure for the design of an axially loaded short column.
19. What are braced columns?
20. State the methods recommend by IS 456 to estimate the effective length of columns.
21. Write any two function of lateral ties in a RC column.
22. Differentiate between long and short column.
23. Differentiate between uniaxial and biaxial
24.

PART - B

1. Design the longitudinal reinforcement in a short column 400mm x 600mm subjected to an ultimate axial load of 1600 KN together with ultimate moments of 120 KN-m and 90KN-m about the major and minor axis respectively. The reinforcements are distributed equally on all four sides. Adopt M20 grade concrete and Fe415 steel bars.
2. Design the reinforcement in a circular column of diameter 350mm with helical reinforcement of 8mm diameter to support a factored load of 1400KN. The column has an unsupported length of 3.5m and is braced against side sway. Adopt M20 grade concrete and Fe415 steel bars.
3. A circular column, 4.6m high is effectively held in position at both ends and restrained against rotation at one end. Design the column, to carry an axial load of 1200KN, if its dia is restricted to 450mm. Use M20 and Fe 415 grades.
4. Design a rectangular column, 5m long restrained in position and direction at both ends, to carry an axial load of 120 KN. uses M20 and Fe415 grades.
5. Design of short column subjected to biaxial bending. Determine the reinforcement for a short column for the following data.

   Column size: 400mmx600mm, P_u=2000KN

   M_{ux}: 160KN, M_{uy}=120KN

   Use M20 grade concrete and Fe415 grade steel.
6. Discuss various assumptions used in the limit state methods of design of compression members.
7. Determine the ultimate load carrying capacity of rectangular column section 400x600mm reinforced with 10nos. Of 25mm dia. Use M25 concrete and Fe415 steel.
8. Design a biaxially eccentricity loaded braced circular column deforming in single curvature for the following data:

   Ultimate load =200KN

   Ultimate moment in longer direction at bottom Mux1=178 KNm and at to [Mux2= 128 KNm.

   Ultimate moment in shorter direction at bottom Muy1=108 KNm and at top Muy2=88 KNm.

   Unsupported length of column = 9m

   Effective length in long direction lex= 8m.

Effective length in short direction ley= 5.8m

Diameter of column = 550mm.

Use M25 concrete and Fe415 steel.

9. Design the reinforcement in short column 400x600mm subjected to an ultimate axial load of 1600KN together with ultimate moments of 120KNm and 90KNm about the major and minor axis respectively. Use M20 grade concrete and Fe415 grade steel.

10. Design the reinforcement required for a column which is restrained against sway using the following data.

    Size of column=530x450mm, l_{eff}=6.6m unsupported length=7.70m.

    Factored load =1600KN. Factored moment about major axis =45KNm at top and 30KNm at bottom. Factored moment about minor axis=35KNm at top and 20KNm at bottom. Use M25 grade concrete and Fe 500 grade HYSD bars. Column is bent in double curvature and reinforcement is distributed equally on all the four sides of the section.

11.Design the reinforcements in short column 400x600mm subjected to an ultimate axial load of 1600kn together with ultimate moments of 120knm and 90knm about the major and minor axis respectively. Use M20 & FE415 grades.

12.Design the reinforcements required for a column which is restrained against sway using the following data.Size of column =530x450mm, l_{eff}=6.6m unsupported length = 7.70m. Factored load =1600kn.factored moment about major axis =45knm at top and 30knm T BOTTOM. Factored moment about minor axis =35knm at top and 20knm at bottom. Use M25 grade concrete and Fe500 grade HYSD bars. Column is bent in double curvature and reinforcement is distributed equally on all the four sides of the section.

12.(i) Discuss various assumptions used in the limit state method of design of compression members.

(ii) Determine the ultimate load carrying capacity of rectangular column section 400x600mm reinforced with 10 nos. Of 25mm dia. Use M25 and Fe415 grades

13. Design a biaxially eccentricity loaded braced circular column deforming in single curvature for the following data

Ultimate load=200knUltimate moment in longer direction at bottom M_{ux1}=178 knm and at top M_{ux1}= 128knm.Ultimate moment in shorter direction at bottom M_{uy1}= 108 knm and at top M_{uy2}= 88knm. Unsupported length of column = 9m.Effective length in long direction l_{ex}=8m.

Effective length in shorter direction l_{ey}= 5.8m.Diameter of column = 550mm.Use M25&Fe415.

14. DESIGN THE REINFORCEMENTS in a circular column of diameter 350mm with helical reinforcement of 8mm diameter to support a factored load of 1400kn. The column has an unsupported length of 3.5 m and is braced against side sway. Adopt M20 grade concrete and Fe415 steel bars.

15. Design the longitudinal reinforcement in a short column 400mmx600mm subjected to an ultimate axial load of 1600kn together with ultimate moments of 120knm and 90knm about the major and minor axis respectively. The reinforcements are distributed equally on all four sides. Adopt M20 grade concrete and Fe415 steel bars

16. (i) A circular column, 4.6m high is effectively held in position at both ends to carry an axial load of 1200kn, if its dia is restricted to 450mm. Use M20 and Fe425 grades.
(ii) Design a rectangular column, 5m long retrained in position and direction at both ends to carry an axial load of 120 kn. Use M20 and Fe415 grades.

17. Design a short column subjected to biaxial bending. Determine the reinforcement for a short column for the following data.
Column size: 400mmx600mm, P_u=200kn
M_{ux}: 160kn, Muy=120kn
Use M20 grade concrete and Fe415 grade steel.

UNIT -5

PART-A

1. How is the main steel distributed in wall footings and two way rectangular footings?
2. What are the factors that influence the selection of number of lifting and hoisting locations of a long beam during its erection process?
3. Define punching shear.
4. What is the main advantage of combined footing?
5. When you need a combined footing?
6. Why check for transfer of load at the base of the column over footing is done?
7. Write any two situations in which combined footings are preferred to isolated footings.
8. What is meant by eccentric loading on a footing?
9. When you need a combined footing?
10. Why check for transfer of load at the base of the column over footing is done?
11. Write any two situations in which combined footings are preferred to isolated footings.
12. What is meant by eccentric loading on a footing?
13. Define punching shear.
14. What is the main advantage of combined footing?
15. How is the main steel distributed in wall footings and two way rectangular footings?
16. What are the factors that influence the selection of number of lifting and hoisting locations of a long beam during its erection process?

17. Sketch the placement of steel in rectangular footing with a non-central load.
18. What are the situations in which combined footings are preferred over isolated footings?
19. Draw a neat sketch of a masonry footing.
20. What is slenderness ratio for a masonry wall? State the maximum values?
21. Compare the behavior of tied and spirally reinforced column.
22. How do you classify one-way footing and two-way footing in foundation?
23. Under what circumstances a trapezoidal footing become necessary?
24. What is a punching shear in a RCC footing?
25. Sketch the reinforcement detailing for the cantilever slab.
26.

PART B

1.Design a suitable footing for a R.C. column of size 300x500mm. Supporting a factored axial load of 1500KN. Assume safe bearing capacity of soil as 200KN/m^2. Adopt M20 grade and Fe415 grades. Sketch the details at reinforcements in footings.

2. Design a combined footing for the two columns at a multi-storey building. The columns of size 400mmx400mm transmit a working load of 300KN each and they are spaced at 5m centres.

The safe bearing capacity of soil at site is 200KN/m^2. Adopt M20 grade concrete and Fe415 grade steel. Sketch the details of reinforcements in the combined footing.

3. A square column of size 400mm carries a service load of 600KN. Design an isolated footing for the column by limit state method, if the safe bearing capacity of the soil is 250KN/m^2. Use M20 concrete and Fe415 steel.

4. A rectangular column of size 300mmx450mm transmits a limit state load of 600KN at an eccentricity of 150mm about the major axis. Design a suitable isolated footing for the column by the limit state concept. Safe capacity of soil is 200KN/m^2.Use M30 concrete and Fe 415 steel.

5.. Design a rectangular isolated footing of uniform thickness for R.C. column bearing a vertical load of 600KN, and having a base size of 400 x 600 mm. The SBC of soil is 120 KN/$m^{2.}$ Use M15 grade concrete and M.S grade-I bars. Draw the reinforcement details.

6. Design an isolated square footing for a column 500mm x 500m transmitting a load of 600KN and a moment of 30 KN-m. The SBC of soil is 1230 KN/m^2 . Use M15 grade concrete and M.S. grade –I bars. Draw the reinforcement details.

7. Sketch the standard detailing of the following:
   (i) Two spans one-way continuous slab with curtailment details.
   (ii) Curtailment details in a tapered cantilever beam.

8. Design a suitable footing for a R.C. column of size 300x500mm. Supporting a factored axial load of 1500kn. Assume safe bearing capacity of soil as 200kn/m^2. Adopt M20&Fe415. Sketch the details at reinforcements in footings.

9. Design a combined footing for the two columns at a multi-storey building. The columns of size 400x400mm transmit a working load of 300kn each and they are spaced at 5m centres. The safe bearing capacity of soil at site is 200kn/m^2. Adopt M20 & Fe415. Sketch the details of reinforcement in the combined footing.

10. A square column of size 400mm carries a service load of 600kn. Design an isolated footing for the column by limit state method, if the safe bearing capacity of the soil is 250kn/m^2. Use M20 & FE415.

11. A rectangular column of size 300x450mm transmits a limit state load of 600kn at an eccentricity of 150mm about the major axis. Design a suitable isolated footing for the column by the limit state concept. Safe capacity of soil is 200kn/m^2. Use M30 &Fe415.

12. Draw the shear force and bending moment diagrams and design the 20mm diameter bars as top steel for maximum hogging moment for a RC rectangular combined footing using the following data:Centre to centre distance between columns: 4m. Each column is square in shape with 400mm side. Each column carries an axial load at service state =1200kn. The projection of footing parallel to the length beyond the axis of each column is 1m.The limiting bearing capacity of soil: 440kn/m^2.Materials used: M20 grade concrete and Fe415 steel bars.

13.Sketch the standard detailing of the following :

(i) Two span one way continuous slab with curtailment details.
(ii) Curtailment details in a tapered cantilever beam.

14. Design a rectangular isolated footing of uniform thickness for R.C. column bearing a vertical load of 600 KN. And having a base size of 400mmx600mm. The SBC of soil is 120 kn/m^2. Use the reinforcement details.

15. Design an isolated square footing for a column 500mmx500mm transmitting a load of 600kn and a moment of 30knm. The SBC of soil is 1230kn/m^2. Use M15 grade concrete and M.S. grade I bars. Draw the reinforcement details.