Design of RCC Structures Important Questions PDF

Design of RCC Structures papers usually follow IS 456:2000 and the limit state method. Expect theory on design philosophy and stress blocks, then design questions on singly and doubly reinforced beams, shear and development length, one-way and two-way slabs, columns and isolated footings. Learn the key clauses and formulas, practise one full design per unit, and check your own university syllabus and official papers.

Key takeaways

- These are practice questions based on common syllabus topics. They are not verified past papers.
- Most universities allow IS 456:2000 in the exam hall. Check your exam rules and practise finding tables quickly.
- Learn Mu,lim factors: 0.149, 0.138 and 0.133 × fck b d^2 for Fe 250, Fe 415 and Fe 500.
- A design answer is not complete without detailing checks: minimum steel, spacing, shear, deflection and a neat sketch.
- Partial safety factors: 1.5 for concrete, 1.15 for steel and 1.5 for dead plus live load.

Before you start: how to use these questions

These questions follow the topics in a standard Indian B.Tech Civil RCC design syllabus based on IS 456:2000. They are practice questions, not copies of any exam paper. Compare them with your own university syllabus and official question papers. AKTU students can use the AKTU old question paper archive, and Uncodemy lists more previous year question paper sources. Use the scientific calculator to check square roots in steel area formulas.

Unit 1: Design philosophy and flexure basics

Definitions (2 to 3 marks)

- Compare the working stress method and the limit state method.
- Define limit state of collapse and limit state of serviceability.
- Define characteristic strength and characteristic load.
- What are under-reinforced, balanced and over-reinforced sections? Why does the code prefer under-reinforced sections?

Derivations

- State the assumptions of limit state design for flexure (IS 456, clause 38.1).

- Derive the stress block parameters: compressive force = 0.36 fck b xu, acting at 0.42 xu from the top.
- Derive xu,max/d. *Answer:* 0.53 for Fe 250, 0.48 for Fe 415 and 0.46 for Fe 500.
- Derive the limiting moment of resistance: Mu,lim = 0.36 fck b xu,max (d - 0.42 xu,max).

Numerical

- Find the limiting moment of resistance of a beam 230 mm wide with effective depth 450 mm, M20 concrete and Fe 415 steel. *Outline:* Mu,lim = 0.138 × 20 × 230 × 450² = 128.5 kN·m.

Unit 2: Beams, shear and bond

Definitions

- When is a doubly reinforced beam needed?
- What is a flanged (T or L) beam? How is effective flange width found?
- Define nominal shear stress and design shear strength of concrete.
- Define development length and anchorage.

Derivations and formulas

- Derive the steel area for a singly reinforced section: Ast = (0.5 fck/fy) [1 - √(1 - 4.6 Mu / (fck b d²))] b d.
- Derive the development length: Ld = φ σs / (4 τbd).
- Explain the design of vertical stirrups: Vus = 0.87 fy Asv d / sv.

Numericals

1. The same beam (230 × 450 mm effective, M20, Fe 415) carries a factored moment of 100 kN·m. Find the steel area. *Outline:* Mu is below Mu,lim, so the section is singly reinforced. Ast = (0.5 × 20/415) × [1 - √(1 - 4.6 × 100 × 10⁶ / (20 × 230 × 450²))] × 230 × 450 ≈ 720 mm². Provide 4 bars of 16 mm (804 mm²) and check minimum steel 0.85 b d / fy.
2. Find the development length of a 16 mm deformed bar of Fe 415 in M20 concrete. *Outline:* τbd = 1.2 × 1.6 = 1.92 N/mm²; Ld = 16 × 0.87 × 415 / (4 × 1.92) ≈ 47φ = 752 mm.
3. Design shear reinforcement for a beam with factored shear 150 kN. *Outline:* τv = Vu / bd; read τc from Table 19 for the steel percentage; check τv is below τc,max (2.8 N/mm² for M20 from Table 20); design stirrups for Vus = Vu - τc b d; check maximum spacing of 0.75d or 300 mm.
4. Design a doubly reinforced beam when Mu exceeds Mu,lim. *Outline:* provide Ast1 for Mu,lim, then design compression steel and extra tension steel for the balance moment.

Unit 3: Slabs

Definitions

- Differentiate one-way and two-way slabs. *Answer:* a slab supported on all four sides acts one-way when ly/lx > 2 and two-way when ly/lx ≤ 2.
- What is the purpose of distribution steel?
- Why are torsion reinforcement bars needed at corners of two-way slabs?

Code points to remember

- Basic span to effective depth ratios (clause 23.2.1): cantilever 7, simply supported 20, continuous 26, modified by tension steel factors.
- Minimum steel in slabs: 0.12% of gross area for HYSD bars and 0.15% for mild steel.
- Maximum spacing: main bars 3d or 300 mm, distribution bars 5d or 300 mm, whichever is less.

Numericals

1. Design a simply supported one-way slab for a room 3.5 m wide with a live load of 3 kN/m² and floor finish of 1 kN/m², using M20 and Fe 415. *Outline:* assume depth from span/depth ratio, compute self weight, factor the total load by 1.5, find Mu = wuL²/8, check depth, find Ast, choose bar spacing, then check shear and deflection.
2. Design a two-way slab with restrained edges using moment coefficients from Table 26 of IS 456. *Outline:* find ly/lx, read αx and αy for the edge condition, find Mux = αx wu lx² and Muy = αy wu lx², design steel in both directions and provide torsion steel at corners.

Unit 4: Columns

Definitions

- Define short and long columns. *Answer:* a column is short when lex/D and ley/b are both less than 12 (clause 25.1.2).
- What is minimum eccentricity? *Answer:* emin = l/500 + D/30, subject to a minimum of 20 mm (clause 25.4).
- State the limits of longitudinal steel: minimum 0.8% of gross area and maximum 6% by code, with 4% as a practical limit. Minimum 4 bars in rectangular and 6 in circular columns.

Derivations

- Derive the axial load capacity of a short column with minimum eccentricity: Pu = 0.4 fck Ac + 0.67 fy Asc (clause 39.3).
- Explain the use of interaction diagrams (SP 16) for columns with uniaxial bending.

Numerical

- Find the axial load capacity of a 400 × 400 mm short column with 1% steel, M25 and Fe 415. *Outline:* Asc = 1600 mm², Ac = 158,400 mm². Pu = 0.4 × 25 × 158,400 + 0.67 × 415 × 1600 = 2029 kN. Check that emin does not exceed 0.05D (20 mm here), and design lateral ties: diameter not less than φ/4 or 6 mm, pitch not more than the least lateral dimension, 16φ or 300 mm.

Unit 5: Footings, staircases and serviceability

Definitions

- Name the types of footings: isolated, combined, strap and raft.
- What are the critical sections for bending, one-way shear and punching shear in an isolated footing?
- What are the limit states of serviceability? Explain deflection and cracking limits.

Numericals

1. Find the plan size of an isolated square footing for a column carrying 1200 kN (service) on soil with a safe bearing capacity of 200 kN/m². *Outline:* add about 10% for self weight: 1320/200 = 6.6 m², so side ≈ 2.57 m; provide 2.6 m × 2.6 m. Then find net upward pressure from factored load and design for bending at the column face, one-way shear at d from the face and punching shear at d/2 (permissible ks × 0.25√fck).
2. Design a dog-legged staircase waist slab. *Outline:* find loads on plan area, factor them, design as a simply supported slab along the going, and detail main and distribution steel.

How to score well in RCC design

- **Write data and assumptions first.** List fck, fy, cover, loads and the clauses you use.
- **Quote clause numbers** only when you are sure. A correct clause adds confidence to the answer.
- **Finish with checks.** Minimum and maximum steel, spacing, shear, development length and deflection.
- **Draw the reinforcement detail.** A labelled cross-section and longitudinal section often carries several marks.
- **Practise official papers.** Solve at least three past papers from your own university under timed conditions.

Frequently asked questions

Are these RCC design questions from past papers?

No. They are practice questions based on topics common to most B.Tech Civil syllabi. Check your own university syllabus and official papers before the exam.

Is IS 456:2000 allowed in the RCC exam?

Many universities allow IS 456 and sometimes SP 16 in the exam hall, but rules differ. Check your exam instructions in advance.

Which designs are most important in RCC?

Singly and doubly reinforced beams, shear design, one-way and two-way slabs, axially loaded columns and isolated footings appear in most syllabi.

What is the value of Mu,lim for Fe 415 steel?

Mu,lim = 0.138 fck b d² for Fe 415. It is 0.149 fck b d² for Fe 250 and 0.133 fck b d² for Fe 500.

When is a column treated as short under IS 456?

When the effective length to lateral dimension ratio is less than 12 in both directions (clause 25.1.2).

Is this PDF free?

Yes. Fill in the short form on this page and the PDF downloads right away.

Sources and further reading

- Bureau of Indian Standards

- AKTU old question papers
- NPTEL: Design of Reinforced Concrete Structures

About this PDF

Prepared by the Uncodemy team as practice material based on common syllabus topics. These are not past papers. Corrections: info@uncodemy.com.

More free resources and courses: uncodemy.com | info@uncodemy.com | +91 98183 66550