Steel Structures Design Important Questions PDF

Design of Steel Structures papers usually follow IS 800:2007 and the limit state method. Expect questions on bolted and welded connections, tension members, compression members with built-up columns and bases, laterally supported beams, and plate girders or roof trusses. Learn the partial safety factors and capacity 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.
- Partial safety factors in IS 800:2007: γm0 = 1.10 for yielding, γm1 = 1.25 for ultimate stress, γmb = 1.25 for bolts, γmw = 1.25 for shop welds and 1.50 for field welds.
- Many universities allow IS 800 and steel tables in the exam. Check your exam rules first.
- Every design should end with checks: slenderness, deflection, shear and connection design.
- Draw the connection or section detail. Sketches carry marks in steel design.

Before you start: how to use these questions

These questions follow topics in a standard Indian B.Tech Civil steel design syllabus based on IS 800:2007. 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. Keep a scientific calculator ready for square roots and buckling formulas.

Unit 1: Introduction and connections

Definitions (2 to 3 marks)

- State the advantages and disadvantages of steel as a structural material.
- List the limit states of strength and serviceability for steel structures.
- Classify sections as plastic, compact, semi-compact and slender. Why does this matter?
- Differentiate bearing type and friction grip (HSFG) bolts.
- Define pitch, gauge, edge distance and end distance.
- Define the effective throat thickness of a fillet weld. *Answer:* 0.7 times the size of the weld for equal legs meeting at 90°.

Formulas to derive or explain

- Bolt shear capacity: Vdsb = fub (nn Anb + ns Asb) / (√3 γmb).
- Bolt bearing capacity: Vdpb = 2.5 kb d t fu / γmb.
- Fillet weld design strength: fwd = fu / (√3 γmw).

Numericals

1. Find the design shear capacity of an M20 bolt of grade 4.6 in single shear with the shear plane through the threads. *Outline:* fub = 400 N/mm²; Anb ≈ 0.78 × π × 20²/4 = 245 mm²; Vdsb = 400 × 245 / (1.732 × 1.25) ≈ 45.3 kN. Then check bearing and take the smaller value as bolt value.
2. Find the strength of a 6 mm shop fillet weld 200 mm long with fu = 410 N/mm². *Outline:* throat = 0.7 × 6 = 4.2 mm; fwd = 410 / (1.732 × 1.25) = 189.4 N/mm²; strength = 189.4 × 4.2 × 200 ≈ 159 kN.
3. Design a lap joint between two plates using a given number of bolts. *Outline:* find bolt value, number of bolts = load / bolt value, arrange with minimum pitch 2.5d and edge distances, then check plate strength.

Unit 2: Tension members

Definitions

- What is shear lag? How does it affect angle sections connected by one leg?
- Define net area, gross area and block shear failure.
- State the maximum slenderness ratio for tension members as given in IS 800 Table 3.

Formulas

- Yielding of gross section: Tdg = Ag fy / γm0.
- Rupture of net section (plates): Tdn = 0.9 An fu / γm1.
- Block shear: the smaller of the two expressions in clause 6.4.1 combining shear yield with tension rupture and shear rupture with tension yield.

Numericals

1. A plate 200 mm × 10 mm (fy = 250, fu = 410 N/mm²) has two M20 bolt holes of 22 mm in one cross-section. Find the design tensile strength. *Outline:* Tdg = 2000 × 250 / 1.1 = 454.5 kN. An = (200 - 2 × 22) × 10 = 1560 mm²; Tdn = 0.9 × 1560 × 410 / 1.25 = 460.5 kN. Check block shear for the bolt layout. Design strength is the least value, here 454.5 kN from yielding unless block shear is lower.
2. Design a single angle tension member connected by one leg for a factored load of 200 kN. *Outline:* trial area from yield, choose an angle, check yielding, net section rupture with the shear lag factor, block shear and slenderness.

Unit 3: Compression members and column bases

Definitions

- Define effective length and slenderness ratio. State the maximum slenderness ratio of 180 for members carrying dead and imposed loads.
- What are buckling classes a, b, c and d? *Answer:* the imperfection factors α are 0.21, 0.34, 0.49 and 0.76 respectively.

- Differentiate lacing and battening in built-up columns.
- What is a slab base and a gusseted base?

Derivations

- Derive Euler's buckling load for a pin-ended column: $P_{cr} = \pi^2 EI / L^2$.
- Explain the design compressive stress formula of IS 800: $f_{cd} = (f_y / \gamma_{m0}) / [\varphi + \sqrt{(\varphi^2 - \lambda^2)}]$, where $\varphi = 0.5 [1 + \alpha(\lambda - 0.2) + \lambda^2]$.

Numericals

1. Find the design compressive strength of a given rolled I-section column with a known effective length. *Outline:* find KL/r about the weaker axis, non-dimensional slenderness λ, choose the buckling class from Table 10, find φ and fcd, then Pd = Ae fcd.
2. Design a built-up column of two channels with lacing. *Outline:* choose spacing so that the radii of gyration about both axes are close, design lacing bars for 2.5% of the axial load as transverse shear, and check lacing slenderness.
3. Design a slab base for a column carrying a factored load of 1000 kN on M20 concrete. *Outline:* bearing strength of concrete = 0.6 fck = 12 N/mm²; base area = 1000 × 10³ / 12 = 83,333 mm²; choose plate size and find thickness from the code formula.

Unit 4: Beams

Definitions

- Differentiate laterally supported and laterally unsupported beams.
- What is lateral torsional buckling?
- Define web buckling and web crippling.
- State the deflection limit for a simply supported beam carrying brittle finishes or as given in IS 800 Table 6.

Formulas

- Design bending strength of a laterally supported beam when shear is low: $M_d = \beta_b Z_p f_y / \gamma_{m0}$, limited to $1.2 Z_e f_y / \gamma_{m0}$ for simply supported beams.
- Design shear strength: $V_d = A_v f_y / (\sqrt{3} \gamma_{m0})$. Shear is "high" when the factored shear exceeds 0.6 Vd.

Numericals

1. A laterally supported plastic section has $Z_p = 650 \times 10^3$ mm³ and $f_y = 250$ N/mm². Find the design bending strength. *Outline:* βb = 1.0 for plastic sections; $M_d = 650 \times 10^3 \times 250 / 1.1 = 147.7$ kN·m. Check the $1.2 Z_e f_y / \gamma_{m0}$ limit using Ze from the steel table.
2. Design a simply supported beam of span 6 m carrying a factored UDL. *Outline:* find Mu and Vu, find required Zp, choose a section, check section class, shear, the high shear condition, deflection under service load, web buckling and crippling.

Unit 5: Plate girders, gantry girders and roof trusses

Definitions

- What is a plate girder? Name its main parts: flanges, web, stiffeners and splices.
- Why are intermediate and bearing stiffeners needed?
- What loads act on a gantry girder? Explain impact and lateral surge loads.
- Name the types of roof trusses: Pratt, Howe, Fink and North light.

Long answers

- Explain the design steps of a welded plate girder.
- Explain how wind load on a roof truss is calculated as per IS 875 (Part 3), using basic wind speed, factors k1, k2 and k3, and pressure coefficients.
- Design a purlin as a laterally supported member under dead, live and wind loads.

How to score well in Steel design

- **Write data, assumptions and γ values first.** It shows the examiner your basis.
- **Use steel tables carefully.** Copy the section properties you use into the answer.
- **Check everything.** Slenderness, section class, shear, deflection and connections.
- **Sketch the joint or section.** Mark bolt spacing, edge distances or weld sizes.
- **Practise official papers.** Solve at least three past papers from your own university under timed conditions.

Use the unit converter if data is given in mixed units such as kN/m and N/mm.

Frequently asked questions

Are these steel 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.

Which code is used for steel design in India?

IS 800:2007, General Construction in Steel, which uses the limit state method. Wind loads come from IS 875 (Part 3).

What are the partial safety factors in IS 800:2007?

γm0 = 1.10 for yielding and buckling, γm1 = 1.25 for ultimate stress, γmb = 1.25 for bolts, and γmw = 1.25 for shop welds and 1.50 for field welds.

Which topics are most important in Design of Steel Structures?

Bolted and welded connections, tension members, compression members with lacing or battens, column bases and laterally supported beams appear in most syllabi.

Where can I find official AKTU steel design papers?

AKTU publishes old question papers at aktu.ac.in/old-question-paper.html. Other universities have their own archives.

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 Steel 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