Questions

1. Explain the advantages and disadvantages of using steel structures.
2. Explain what is structural steel. List out the important properties of such steel.
3. Explain the special considerations required in the design of steel structures.
4. Explain briefly various types of loads to be considered in design of steel structures.

1. Explain the principles of
   (a) Working stress method of design
   (b) Ultimate load design and
   (c) Limit state design.
2. Explain how limit state method differs from working stress method of design.
3. Explain how limit state design differs from ultimate load design.
4. Explain the following terms
   (a) Partial safety factor for loads
   (b) Partial safety factor for material strength.
5. Distinguish between
   (a) Factor of safety and partial safety factor
   (b) Characteristic loads and design (factored) loads.

1. Write short notes on
   (a) Riveted connection.
   (b) HSFG bolts.
2. Distinguish between
   (a) Black bolts and turned bolts.
   (b) Bearing bolts and friction grip bolts.
3. Discuss the advantages and disadvantages of
   (a) Riveted connection and bolted connection.
   (b) Bearing bolts and HSFG bolts.
   (c) Black bolts and turned (finished) bolts.
4. Explain the following terms:
   (a) Pitch of Bolts
   (b) Gauge Distance
   (c) Edge Distance
   (d) Staggered Distance
   (e) Tacking Bolts.
5. List the assumptions made in the design of bearing bolts.
6. Two plates 16 mm are to be joined using M20 bolts of grade 4.6 in
   (a) Lap joint.
   (b) Butt joint using 10 mm cover plates.
   Determine the bolt value.
7. If the joint specified in Question 6 is made with M20 HSFG of grade 8.8, find the bolt value. Take coefficient of friction = 0.48.
8. An angle section 8 mm thick carrying 120 kN factored load is to be connected to a gusset plate (lap joint) using M20 bolts of grade 4.6. Find the number of bolts required and sketch the connection details.
9. The plates of a boiler are 10 mm thick, connected by M16 bolts of grade 4.6 at a spacing of 50 mm. If it is lap joint, determine the efficiency of the connection.

1. What are the advantages and disadvantages of welded connections?
2. Neatly sketch the following welded connections:
   (a) Butt weld (groove weld) – single V, double V
   (b) Fillet weld
   (c) Slot weld
   (d) Plug weld.
3. Two 12 mm thick plates are joined by 160 mm long (effective) butt weld. Determine the strength of joint if
   (a) Single U butt weld is used.
   (b) Double U butt weld is used.
4. Design a suitable longitudinal fillet weld to connect 120×8 mm plate to 150×10 mm plate to transmit a pull equal to the full strength of small plate. Assume welding is to be made in the field.
5. A tie member of a roof truss consists of 2 ISA 9060, 10 mm. The angles are connected on the either side of 12 mm gusset plate and the member is subjected to a factored pull of 350 kN. Design the welded connection. Assume welding is to be made in the workshop.
6. Two plates 180 mm wide and 8 mm thick are to be connected by welding, using shop welds, design the connection.

1. Explain the different modes of failure of tension members.
2. Write short note on block shear failure.
3. What is a lug angle? Illustrate with sketch. Why lug angles are used?
4. Write short notes on tension member splices.
5. Determine the tensile strength of the plate 160 mm × 10 mm with the holes for 24 mm bolts shown in Fig. 5.14.
6. Determine the tensile strength of a roof truss diagonal 100 × 75 × 10 mm. The longer leg connected to the gusset plate with 20 mm diameter bolts in one row. Number of bolts used i the edge/end distance = 30 mm and pitch = 50 mm.
7. A member consists of a single angle ISA 150 × 75. It is to be connected to the gusset plate by rows of 20 mm diameter bolts at a pitch of 80 mm with a stagger of 40 mm. The first line of bo located at their centres 50 mm from the back of the angle while the second row is located at 60 from the first row. The tensile force (working) is 200 kN. Calculate the thickness of angle.
8. Design a tension member to carry a factored force of 340 kN. Use 20 mm diameter black b and a gusset plate of 8 mm thick.
9. A tension member of truss consists of a single angle ISA 125 × 75 × 10 mm carrying a fact load of 300 kN, if 20 mm diameter bolts are used. Design the connection to a gusset plate u a lug angle.

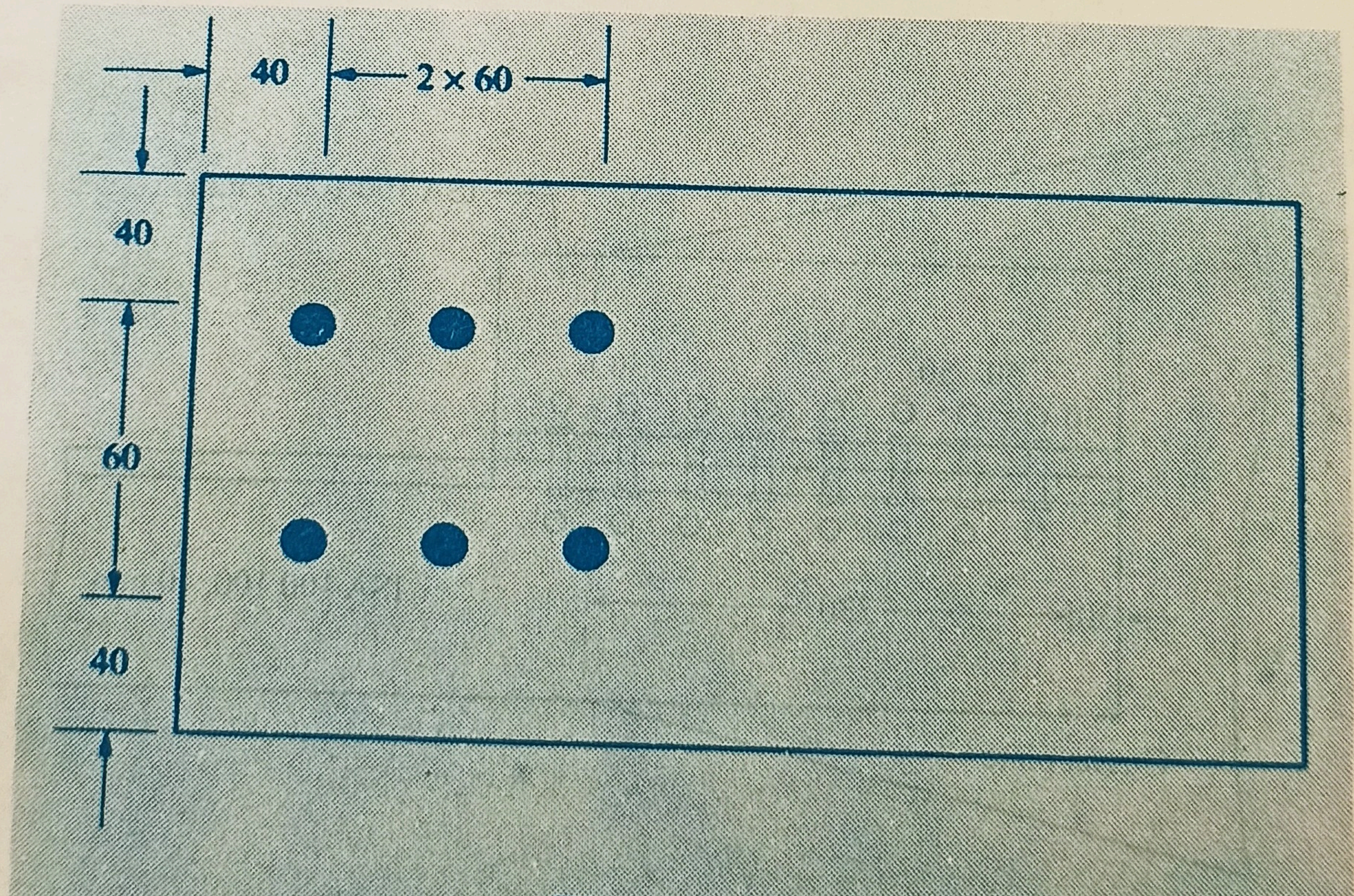

Figure 5.14

1. With neat sketches explain different types of the following:
   (a) splices
   (b) base connections.

2. Determine the load carrying capacity of a strut made with ISA 10075, 10 mm, if its length is 2.8 m in the following cases of end connections:
   (a) one bolt used
   (b) two bolts used
   (c) welded rigidly to gusset plate.

3. Determine the load carrying capacity of a strut made with 2 ISA 7575, 6 mm, back to back if the length of member is 3.0 m and welded to a 12 mm gusset plate.

4. An ISMB 150 is used as a column. It is laterally supported in the plane of the major axis at a height 2.5 m and in the plane of minor axis at a height of 4.5 m. The ends may be assumed as hinged. What will be the allowable load on the column?

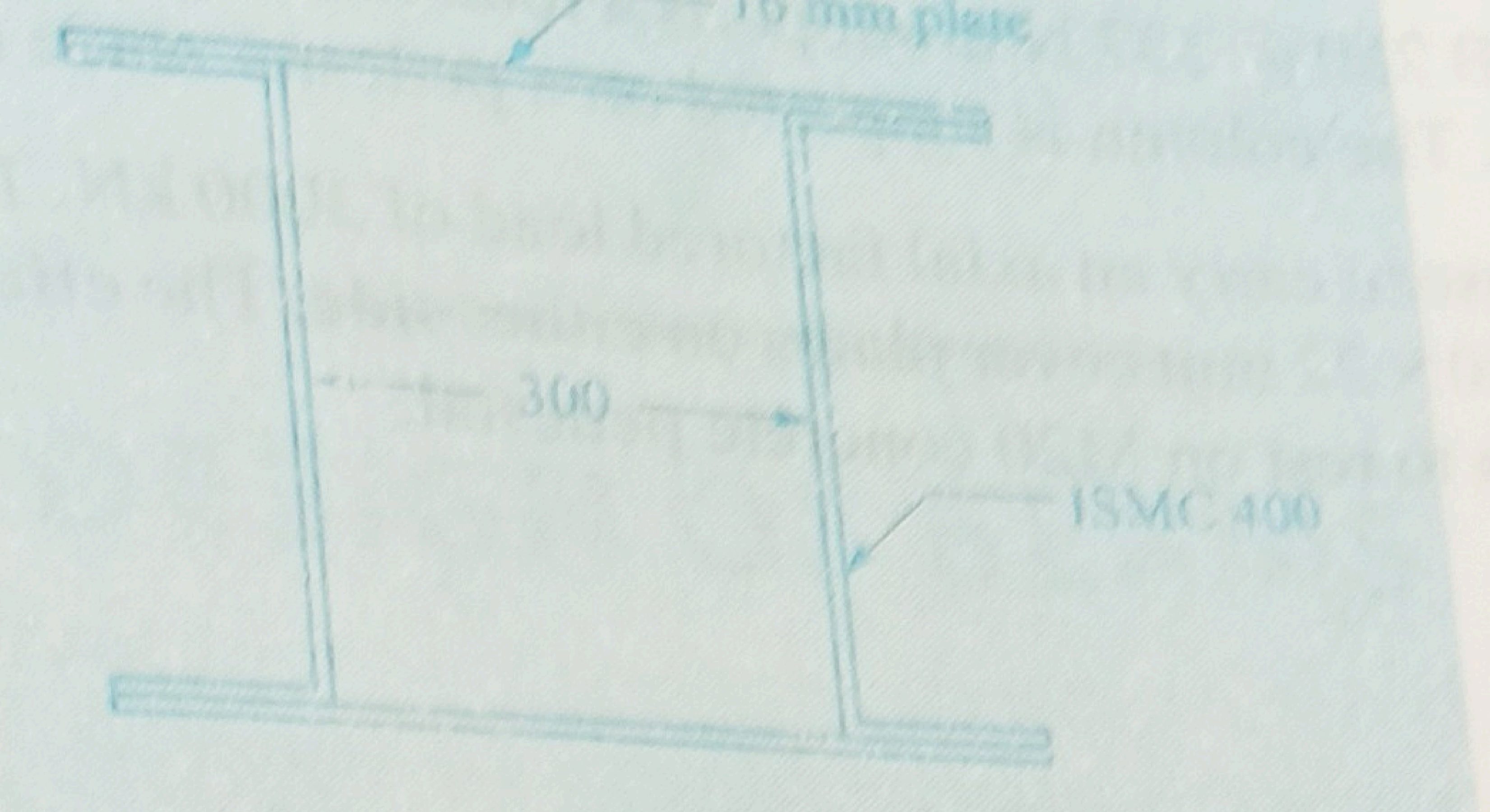

Figure 6.19

5. Determine the allowable compressive load which the member shown in Fig. 6.19 can support if the member is having 5.5 m effective length. Assume E 250 (Fe 415) grade steel.

6. Design a double angle strut to carry an axial factored load of 240 kN. The length of strut is 3.0 m. Bolted connections are to be used to connect it to 12 mm gusset plate.

7. A column 5 m long, has to support a factored load of 3600 kN. The column is held effectively at both ends and restrained in direction at one end. Design the column using beam sections and plates.

8. A column of 9 m effective length has to support an axial factored load of 1500 kN. Design the column which shall consist of two channels placed back to back at suitable spacing. Design also single angle lacing system.

9. Design a built up column consisting of two channels placed toe to toe. The column carries an axial factored load of 1600 kN. The effective height of the column is 10 m. Design the lacing also.

10. Design the column given in example 6.9 using battens instead of lacing system.

11. A column section ISHB 350 @ 710 N/m is carrying a factored load of 800 kN, a factored moment of 30 kN-m and a factored shear of 80 kN. Assuming ends are milled, design a suitable column splice.

12. An upper storey column ISHB 300 @ 577 N/m carries a factored load of 1200 kN and a factored moment of 12 kN-m. It is to be spliced with lower storey column ISHB 350 @ 710 N/m. Design a suitable splice.

13. A steel column ISHB 250 @ 537 N/m supports a total factored load of 1000 kN. Design a slab base for the column. The column is supported on a pedestal made of M20 concrete.

14. Design a gusseted base to carry an axial factored load of 3000 kN. The column is ISHB 450 @ 855 N/m with two 250 × 22 mm cover plates on either side. The effective height of the column is 5 m. The column is to rest on M20 concrete pedestal.