



**SNS College of Technology,
Coimbatore- 35(Autonomous)
B.E/B.Tech– Internal Assessment Examination I
Department of Civil Engineering**



**Academic Year 2023-2024 (Even)
VI Semester
19CET304 – DESIGN OF STEEL STRUCTURES
Unit I**

1. What are the advantages of bolt connections over riveted connections?

- There is a silence in preparing bolted connection. In riveting, hammering is done. The hammering causes noise in the riveting.
- There is no risk of fire in bolted connections. The rivets are made red hot in riveting and there is risk of fire.
- The bolted connections may be done quickly in comparison to the riveting.
- Noiseless
- Easy to dismantle and reuse the materials.

2. Mention the types of failures in a riveted joint?

- Shear failure of rivets
- Shear failure of plates
- Tearing failure of rivets
- Bearing failure of plates
- Splitting failure of plates at the edges
- Bearing failure of rivets

3. What are the various failure modes of bolted connections?

- Shear failure of bolt
- Shear failure of plates
- Tension failure of plate or tension failure of bolt
- Bearing failure of plate or bearing failure of bolt

4. What is HSFG Bolt?

HSFG (High Strength Friction Grip) bolts are made from high strength steel rods. Surface of the shank is kept unfinished in case of black bolts. These bolts are tightened to a proof load using calibrated wrenches. Hence they grip the members tightly.

5. List out the different types of bolts.

- Unfinished bolts
- Turned bolts
- Black bolts

- High strength bolt

6. Name any two important advantages of structural steel.

- They can erect at a faster rate.
- Steel is the ultimate recycling material.
- Properly maintained steel structures have a long life.
- Additions and alteration can be made easily to steel structures.
- These properties of steel mostly don't change with time.
- This makes steel most suitable material for its structure

7. Define the limit states.

The acceptable limit for the safety and serviceability requirements before failure occurs is called as limit state.

8. State the different limit states.

- Limit state of strength.
- Limit state of serviceability.

9. What are the advantages of bolted connections?

- There is silence in preparing bolted connection. In riveting, hammering is done. The hammering causes noise in the riveting.
- There is no risk of fire in bolted connection. The rivets are made red hot in riveting and there is risk of fire.
- The bolted connections may be done quickly in comparison to the riveting.
- Though the cost of bolts is more than the cost of rivets, the bolted connections are economical to use because less persons are required for installation, and the work proceeds quickly.
- Noiseless
- Easy to dismantle and reuse the materials.

10. Define: efficiency of a joint

$$\text{Efficiency of a joint, } \eta = \frac{\text{strength of bolted joint} / \text{pitch length}}{\text{strength of solid plate} / \text{pitch length}} \times 100$$

11. What are the disadvantages of bolted connections?

- Tensile strength is reduced considerably due to stress concentrations and reductions of area at the threads.
- Rigidity of joints is reduced due to loose fit, resulting into excessive deflections.
- Due to vibrations nuts are likely to loosen, endangering the safety of the structures.

12. What are the properties of structural steel?

- Density. Density of a material is defined as mass per unit volume.
- Elastic Modulus.
- Poisson's Ratio.
- Tensile Strength.
- Yield Strength.
- Melting Point.

- Specific Heat.
- Hardness.

13. How the rolled steel beams are classified?

- Indian Standard junior beams (ISLB)
- Indian Standard light beams (ISLB)
- Indian Standard medium weight beams (ISMB)
- Indian Standard wide flange beams (ISWB)

14.. What are the load combinations for the design purposes?

- Dead load + Imposed Load (Live load)
- Dead Load + Imposed Load + Wind Load or earthquake load
- Dead Load + Wind Load or Earthquake load

15. Mention the advantages and disadvantages of steel

structures? Advantages:

- Ability to resist high loads
- Due to its high density, steel is completely non-porous
- Durability
- Easy to disassembling or replacing some steel members of a structure

Disadvantages:

- Corrosion
- At high temperature steel loses most of its strength, leading to deformation or failure

16. How the loads are classified?

- Dead load
- Live load
- Earthquake load
- Wind load
- Dynamic loads.

17. What is a partial safety factor?

The safety of the structure depends on each of the two principal design factors namely, load and material strength, which are not the functions of each other. Each of the two factors contributes partially to safety and they are termed as partial safety factors

18. What are the various types of connections used for connecting the structural members?

- Riveted connections
- Bolted connections
- Pin connections
- Welded connections

19. Define Pitch & Gauge Distance

- Pitch: It is the distance between the centres of two consecutive bolts measured along a row of bolts (Gauge Line). It is denoted by p.

- Gauge Distance: It is the distance between the two consecutive bolts of adjacent rows and is measured at right angles to the direction of load. It is denoted by g .

20. Define edge Distance

Edge distance (e) : It is the distance of center of bolt hole from the adjacent edge of plate.

21. What are the various types of bolts used for structural purposes?

- Unfinished bolts
- Turned bolts
- Black bolts
- High strength bolts

22. What are the advantages of HSFG bolts?

- Do not allow slip between the connected members.
- Loads are transferred by friction only.
- Due to high strength less number of bolts are required.
- No noise pollution
- Deformation is minimized.

23. Define nominal diameter and gross diameter of bolt.

Nominal diameter of bolt:

The nominal diameter of a bolt is the diameter of unthreaded shank of bolt.

Gross diameter of bolt:

The gross diameter of a bolt is the nominal diameter of the bolt.

24. Define weld.

The welding is one of the methods of connecting the structural members. In the welding, a metallic link is made between the structural members. The weld is defined as a union between two pieces of metal at faces rendered plastic or liquid by heat or by pressure or both

25. Write about the advantages of welding.

- There is silence in the process of welding.
- There is safety of welding operator in the welding
- The welding may be done quickly in comparison to the riveting.
- The welded joints have better appearance than riveted joints.
- The welded joints are more rigid than the riveted joints

26. Write about the disadvantages of welding.

- The members are likely to distort in the process of welding.
- A welded joint fails earlier than riveted joint, if the structure is under fatigue stresses.

- There is a greater possibility of brittle fracture in welding than the rivet.
- The inspection of welded joint is more difficult and more expensive than the riveted joint.
- More skilled person is required in the welding than in the riveting

27. List the various types of welded joints.

- Butt weld
- Fillet weld
- Slot weld and plug weld
- Spot weld

28. What are properties of structural steel

2.2.4 Properties

The properties of structural steel for use in design, may be taken as given in 2.2.4.1 and 2.2.4.2.

2.2.4.1 Physical properties of structural steel irrespective of its grade may be taken as:

- Unit mass of steel, $\rho = 7850 \text{ kg/m}^3$
- Modulus of elasticity, $E = 2.0 \times 10^5 \text{ N/mm}^2$ (MPa)
- Poisson ratio, $\mu = 0.3$
- Modulus of rigidity, $G = 0.769 \times 10^5 \text{ N/mm}^2$ (MPa)
- Co-efficient of thermal expansion $\alpha_t = 12 \times 10^{-6} / ^\circ\text{C}$

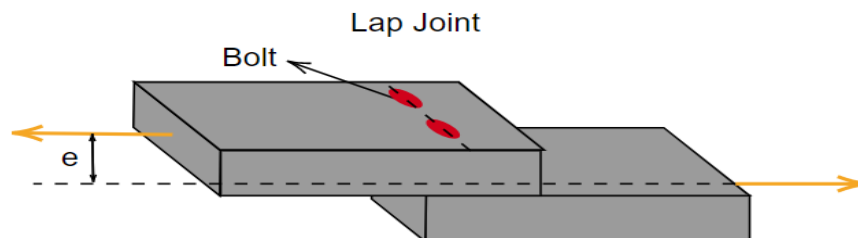
2.2.4.2 Mechanical properties of structural steel

The principal mechanical properties of the structural steel important in design are the yield stress, f_y ; the tensile or ultimate stress, f_u ; the maximum percent elongation on a standard gauge length and notch toughness. Except for notch toughness, the other properties are determined by conducting tensile tests on samples cut from the plates, sections, etc, in accordance with IS 1608. Commonly used properties for the common steel products of different specifications are summarized in Table 1.

29. What are the types of Joints in Bolted Connections?

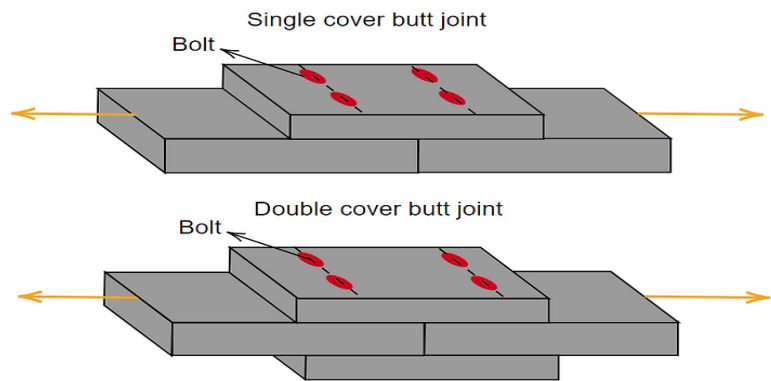
1. Lap Joint

In a lap joint, the main members to be connected are placed over one another to form an overlap between the members, and then the bolting is done on the overlapped portion. Because of the very nature of the connection, an eccentricity is produced.



2. Butt Joint

In this type of joint, a cover plate is used to join two members. Based on the number of cover plates there are two types of butt joint namely, single cover butt joint and double cover butt joint.



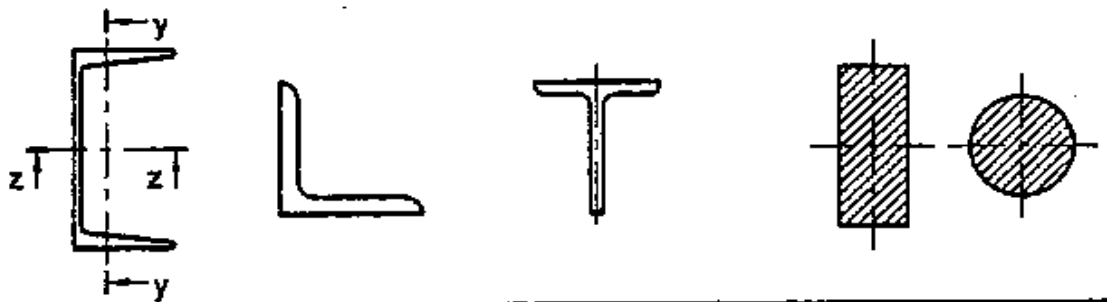
30. Write difference between fillet and butt weld

Difference Between Fillet Weld And Butt Weld

| Fillet Weld | Butt Weld |
|---|---|
| simple, fast and economical to make | more expensive than fillet welds because of the edge preparation required |
| no prior edge preparation is necessary, | easily designed and fabricated to be as strong as the member |
| does not require very skilled labour. | require more skilled manpower, than that required for filled welds. |
| less attractive in appearance. | better appearance, compared to fillet welds, and |
| poorer performance under fatigue loading, and | better fatigue characteristics, compared to fillet welds, |
| Throat thickness= $0.707 \times$ weld size | Thickness= $(5/8) \times$ thickness of thinner plate |
| not appropriate to transfer forces large in magnitude | easy to detail and the length of the connection is considerably reduced. |

31.Give the sketches of steel sections?

Channel, Angle, T and Solid Sections



PART B

1. A single-bolted double-cover butt joint is used to connect two plates which are 8 mm thick. Assuming 16 mm diameter bolts of grade 4.6 and cover plates to be 6 mm thick, calculate the strength and efficiency of the joint, if 4 bolts are provided in the bolt line at a pitch of 45 mm as shown in **Fig. 1**. Also, determine the efficiency of the joint if two lines of bolts with two bolts in each line have been arranged to result in a double-bolted double-cover butt joint.

Also determine the efficiency of the joint if two lines of bolts with bolts in each line have been arranged to result in a double –bolted cover butt joint. **Fig.2**

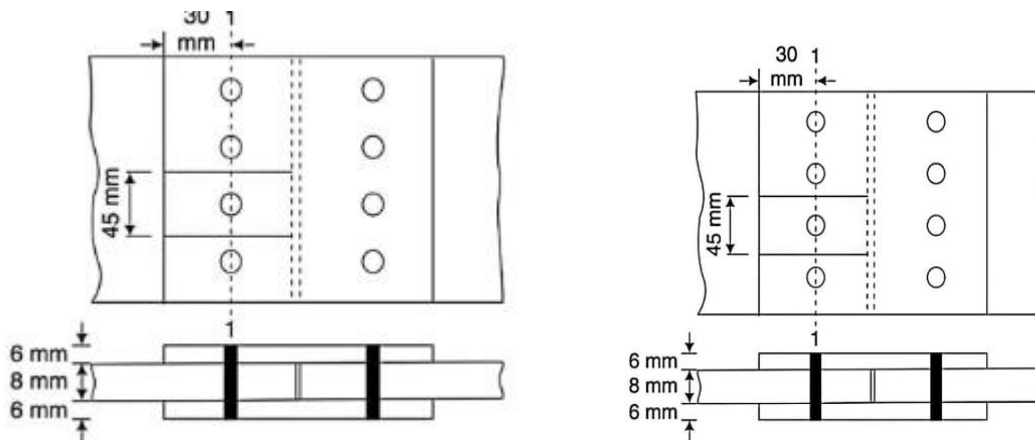
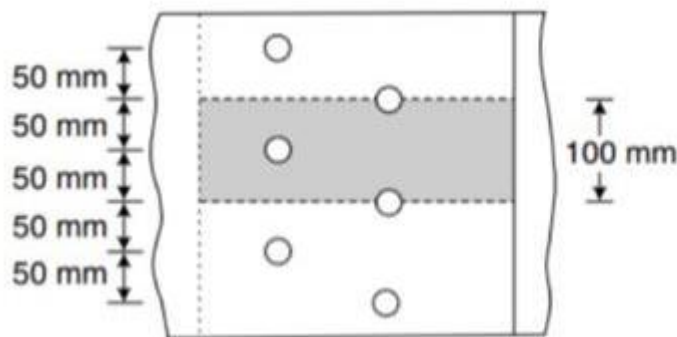


Figure 1

Figure 2

2. Determine strength and efficiency of the lap joint as shown in fig. The bolts are 20mm diameter and 4.6 grade. The two plates to be joined are 10mm and 12mm. Steel grade is Fe410.

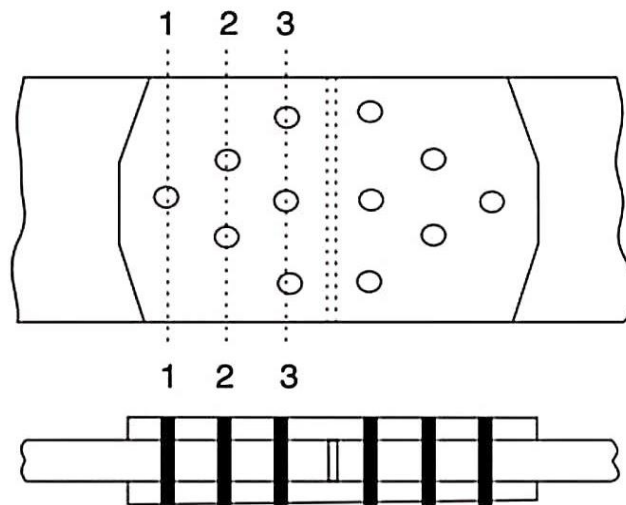


3. Two flats Fe 410 grade steel each 210mmx 8mm are to be joined using 16mm diameter 4.6 grade bolt to form a lap joint. The joint is supposed to transfer a factored load 240kN. Design the joint and determined suitable pitch for the bolts

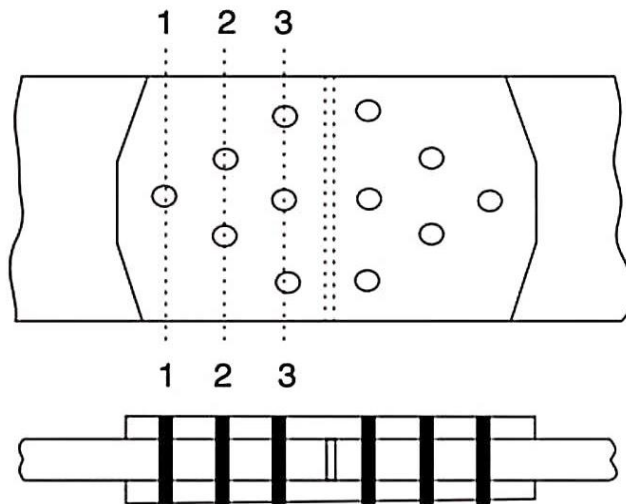
4. Two flats Fe 410 grade steel each 210mmx 8mm are to be joined using 18mm diameter 4.6 grade bolt to form a lap joint. The joint is supposed to transfer a factored load 250kN. Design the joint and determined suitable pitch for the bolts.

5. Two ISF section 200mm X 10mm each and 1.5m long are to be jointed to make a member length of 3.0m. Design a butt joint with the bolts arranged in the diamond pattern. The flat are supposed to carry a service load 300KN. 20mm diameter bolts of grade 4.6 are used to make the connections. Also, determine the net tensile strength of the main plate and cover plate. Steel is of grade Fe410.

6. Two ISF section 200mm X 10mm each and 1.5m long are to be jointed to make a member length of 3.0m. Design a butt joint with the bolts arranged in the diamond pattern. The flat are supposed to carry a service load 450KN. 20mm diameter bolts of grade 4.6 are used to make the connections. Also, determine the net tensile strength of the main plate and cover plate. Steel is of grade Fe410.



7. Two ISF section 200mm X 10mm each and 1.5m long are to be jointed to make a member length of 3.0m. Design a butt joint with the bolts arranged in the diamond pattern. The flat are supposed to carry a service load 300KN. 20mm diameter bolts of grade 4.6 are used to make the connections. Also, determine the net tensile strength of the main plate and cover plate. Steel is of grade Fe410.



8. Two plates of 16mm and 14mm thick are to be joined by groove weld . The joint is subjected to a factored tensile force of 430kN. Effective length of weld is 175mm.

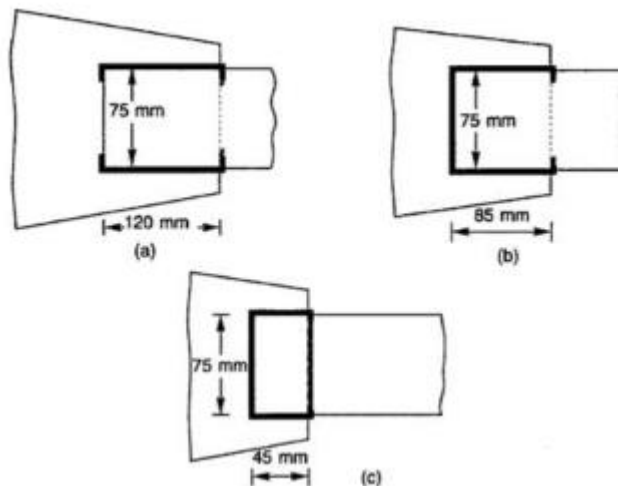
Check the safety of the joint if

(a) Single –V groove weld is provide

(b) Double –V groove weld is provided

Assume the plates to be shop welded

9. A tie member 75mm x 8mm is to be transmit a factored load of 145kN. Design the fillet welds and necessary overlaps for cases as shown if figures. The steel grade is Fe410. Assume gusset plate to be 12mm thick



10. An ISLC 300 @ 324.7 N/m (Fe 410 grade of steel) is to carry a factored tensile force of 900 kN. The channel section is to be welded at the site to a gusset plate 12 mm thick. Design a fillet weld, if the overlap is limited to 350 mm.