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 II – Design of Tension members

1. Define tension member.

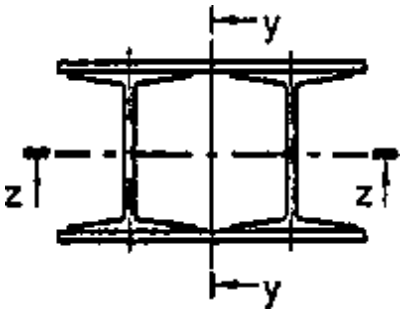
A tension member is defined as a structural member subjected to tensile force in the direction parallel to its longitudinal axis. A tension member is also called as a tie member or simply a tie

2. What are the various types of tension members?

- Wires and cables
- Rods and bars
- Single structural shapes and plates
- Built-up members

3. What is meant by built-up members? (IS800:2007-Pg: 1)

Two or more than two members are used to form built-up members. The built-up sections may be made more rigid and stiffer than the single structural shapes. A built-up section may be made of two channels placed back to back



4. Define slenderness ratio. (IS800:2007-Pg: 4)

The slenderness ratio of a tension member is the ratio of its unsupported length (l) to its least radius of gyration (r).

Slenderness ratio, $\lambda = l/r$.

5. What is net sectional area?

The net sectional area of a tension member is the gross-sectional area of the member less the maximum deduction for holes.

Anet = Agross – sectional areas of holes back with a gusset plate in between them.

6. **How to calculate net area in (a) chain bolting (b) zigzag bolting. (IS800:2007-Pg: 33)**

a) Chain bolting

Net area, $A_n = (b - n\, d_h)\, t$

b) **Zigzag bolting**

$$A_n = \left[b - n d_h + \sum_i \frac{p_{si}^2}{4 g_i} \right] t$$

7. What is block shear?

For some connections configurations, the tension member can fail due to 'tear-out' of material at the connected end. This is called block shear

8. What is shear lag effect?

The tensile force is transferred from gusset to the tension member (such as angle, channels or T-sections) through one leg by bolts or welds. In this process initially the connected leg may be subjected to more stress than the outstanding leg and finally the connection. Thus one part lags behind the other, this is referred to as shear.

9. Differentiate gross and net area

Gross area:

Total area of the cross section which can be taken as equal weight of the member per unit length divided by density of the material is called the gross area. The sectional area given by manufacture is taken as the gross area.

Net area:

The net sectional area of a tension member is the gross sectional area of the member less than maximum detection for holes.

10. What is the difference between the pitch and staggered pitch?

Pitch(S):

It is the distance between centers of two adjacent rows of bolt/rivets in a row. It is measured parallel to the direction of the force.

Staggered pitch:

It occurs in the case of zigzag riveting/bolt between the double bolt/rivet lines. This is the c/c distance between any two consecutive bolts /rivets. It is measured parallel to the direction of the **force acting on the member.**

15. What are the failures in tension members?

1. Gross section yielding
2. Net section rupture
3.. Block shear failure

16. What do you understand by block shear failure?

Block shear failure is characterized by tearing out of a segment or block of material at the end of the member for a certain connection configurations and in coped beams. The block shear failure occurs along a path involving tension on one plane and shear on a perpendicular plane.

17. Give the properties of ISMC 300.

Refer steel table

18.What do you understand by Gross area?

Total area of cross section which can be taken as equal weight of the member per unit lengthdivided by density of the material is called Gross area. The sectional area given by the manufacturer istaken as the gross area.

19.Explain shear lag effect. (IS800:2007-Pg: 4)

The tensile force is transferred from gusset to the tension member (such as angles, channels or T-sections) through one leg by bolts or welds. In this process initially the connected leg may be subjected to more stress than the outstanding leg and finally the stress distribution becomes uniform over the section away from the connection. Thus one part lags behind theother; this is referred to as shear lag.

1.3.88 ***Shear Lag*** **— The in plane shear deformation effect by which concentrated forces tangential to the surface of a plate gets distributed over the entire section perpendicular to the load over a finite length of the plate along the direction of the load.**

20 What is a Lug angle?

In order to increase the efficiency of the outstanding leg in single angles and to decrease thelength of the end connections, sometimes a short length angle at the ends are connected to the gusset andthe outstanding leg of the main angle directly, as shown in Fig.. Such angles are referred to as lug angles.It also reduces shear lag.

21. Where do you use lug angles?

- the connection are small
- The size of gusset plate is economical

- To reduce the length of the joint

22. Write the purpose of using lug angles.

1. To reduce the length of connection to the gusset plate
2. To reduce shear lag effect.

23. What is tension splice?

When a butt joint is covered by plates on both sides, then it is called splicing. The cover plates used to joint tension members are known as tension splice. Tension splicing is done in the following two cases:

- When the size of tension member changes at different length.
- When the length of the section available is less than the required.

24. **Write note on tension member splice.**

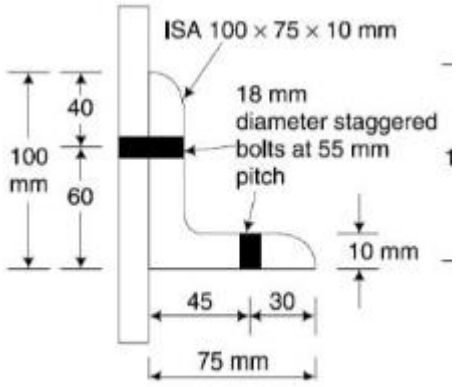
A tension member is spliced when the available length is less than the required length of thetension member. A tension member is also spliced when the members of different thickness are requiredto be connected. In such a case packing is required to fill up the gap.

25. Why is tension splice needed?

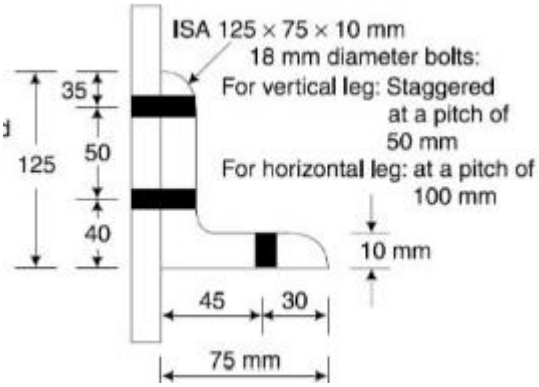
Splices : Splices in tension member are used to join two sections when a joint is to be provided i.e. these replaces the members at the joint where it is cut. The splice section as well as the connection are designed for the tensile load to be transmitted by the main tension member i.e. for the strength of main member.

PART B

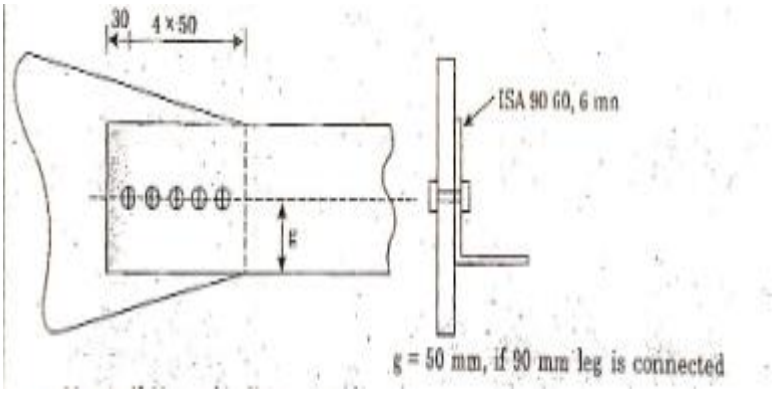
1. Determine the net effective are of angle section as shown in fig. The angles are connected with 18mm diameter bolts of grade 4.6, Grade of steel is Fe410



2. Determine the net effective are of angle section as shown in fig. The angles are connected with 18mm diameter bolts of grade 4.6, Grade of steel is Fe410



3. A single unequal ISA 90 x60 X 6mm is connected to 10mm gusset plate at the end with 5 numbers of 16mm diameter bolts to transfer tension. Determine the tensile strength of the angle if the gusset plate is connected to 60mm leg. Take pitch as 40mm and edges distance as 30mm.
Also check for reversal stress or slenderness ratio.. Taking length = 2.5m

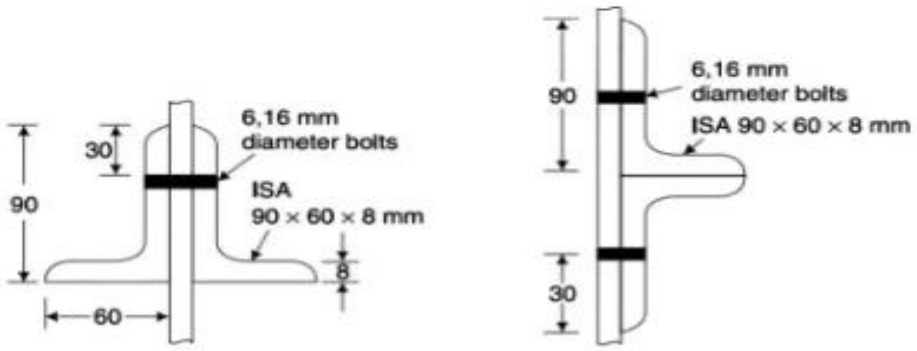


4.

Example 7.4 Determine the effective net area of double angle section connected to a gusset plate, 12 mm in thickness, as shown in Fig. , for the following data.

Diameter of bolts = 16 mm
Number of bolts = 6
Pitch of bolts = 40 mm
Edge distance of bolts = 30 mm
Grade of bolts: 4.6
Grade of steel: Fe 410 (f_y = 250 MPa)
Angles: tack bolted

What will be the effective net area if the angles are not tack bolted?



5. Determine the design tensile strength of the plate 120 mm x 8 mm connected to a 12 mm thick gusset plate with bolt holes as shown in Fig. 11. The yield strength and ultimate strength of the steel used are 250 MPa and 400 MPa. The diameter of the bolts used is 16 mm.

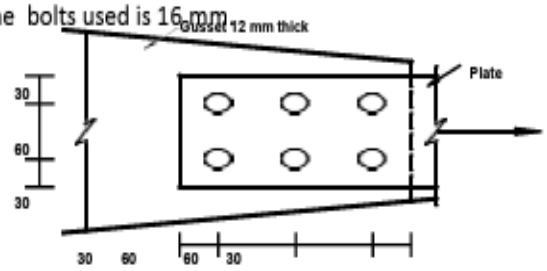


Fig. 11 Details of end connection

6. A single unequal angle 100 x 75 x 8 mm is connected to a 12 mm thick gusset plate at the ends with 6 numbers of 20 mm diameter bolts to transfer tension as shown in Fig. 13. Determine the design tensile strength of the angle if the gusset is connected to the 100 mm leg. The yield strength and ultimate strength of the steel used are 250 MPa and 400 MPa. The diameter of the bolts used is 20 mm.

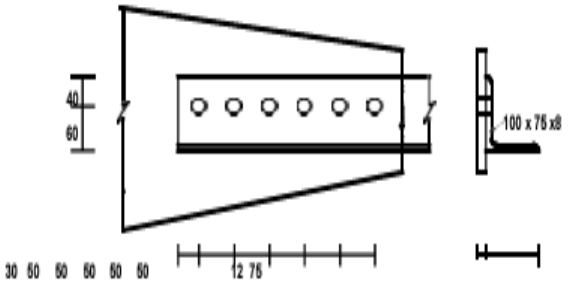


Fig. 13 Details of end connection

7.Design a tie member consisting of single angle section to carry a working load of 150kN. Use bolted connection with M18 of 4.6 grade bolt. If the length of the member is 2m,check the slenderness ratio.

8. Design a splice for joining tension member sections 160 x 10mm and 250x14mm. The member is subjected to factored tensile load of 300kN.Assume Fe410 grade steel. Provide 20mm diameter bolts of grade 4.6, for making connections.

9. Design a splice to connect a 300mm x 20mm with a 300mm x 10mm plate. The factored design load is 500kN. Use 20mm diameter black bolt.