TWO MARKS - QUESTIONS & ANSWERS
UNIT – I - CONNECTIONS – RIVETED, WELDED & BOLTED

1. 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

2. What is meant by Girder?

Girder means a major beam frequently at wide spacing that supports small beams.

3. What is meant by joists?

It is a closely spaced beam supporting the floors and roofs of buildings

4. What is meant by Purlins?

It is a roof beam usually supported byrusses

5. What is meant by Rafters?

t is a roof beam usually supported by purlins

6. What is meant by Lintel?

It is a beam over window or door openings that support the wall above.

7. What is Girts?

It is horizontal wall beams used to support wall covering on the side of an industrial g 8. building

What is meant by Spandrel beam?

It is beam around the outside perimeter of a floor that support the exterior walls and the outside edge of the floor

9. Name the different types of nections?

Riveted connections

Welded

connections Bolted

connections Pinned

connections

10. What is meant by rivet value?

The least of the strengths in shearing and bearing is the rivet value

12. What is meant by gauge distance?

The perpendicular distance between two gauge lines, is called gauge distance

13. Name the different modes of failure of a riveted joint?

Tearing failure of the plate

Shear failure of the the

Slate Shear failure of

Slate Shear failure of

rivet Bearing failure of

the rivet Splitting failure

of plate

14. As per the American practice where the neutral axis lie in the rivet group?
    It is assumed that the line of rotation lies at a distance of 1/7 the of the effective bracket depth from the bottom of the bracket
15. What are the factors that govern will govern the structural design? Foundation movements

    Elasticaxial

    shortening Soil and

    fluid pressures

    Vibration

    Fatigue

    Impact (dynamic

    effects) Erection loads
16. 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
17. What are the steps involved in structural design? Forces or loads

    Structural arrangement and material selection Analyzing internal stresses

    Proportioning of members
18. Which type of steel is most commonly used in general construction? Why?
    Mild Steel is most commonly used in general construction because of its urability and malleability
19. What are Black bots? Where are they used?
    Black bolts made from M.S shank left unfinished – remain loose in holes resulting in large deflections. It is used during erection and for temporary structures
20. 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)

21. Define permissible stresses and Working stresses.

$$\text{Permissible stresses} = \frac{\textit{yield}\ \text{stress}}{\text{factor of safety}}$$

Working stresses: The stresses used in practical design are working stresses and they should never exceed the permissible stresses specified by codes.

22. Explain ISLB 200?

ISLB 200 means Indian Standard light gauge beams of depth 200mm

23. Name the types of beam connections? Framed connections

Seated connections – Stiffened connections and Unstiffened connections

24. What is meant by framed connections?

A framed connection is the one when a beam is connected to girder or a stanchion by means of two angles placed on the two sides of the web of the beam

25. When the seated beam connections are preferred and name the types?

When a beam is connected to the flange (or the web) of a steel stanchion, the width of the flange (or the depth of the web) may be insufficient to accommodate the connecting angles, in such cases framed connection is not suitable and seated connection is preferred.

26. What is unstiffened seat connection?

The seated connection is a horizontal angle with its horizontal leg at its top is used to receive the beam on it, in such a case it is called unstiffened seat connection

27. What is stiffened seat connection?

In addition to the seat angle, a web cleat is provided when the beam is connected to a beam and a flange cleat is used when the beam is connected to a stanchion. The angle cleats are essential because they keep the beam stable in a vertical position and prevent it from lateral buckling

28. What is meant by throat thickness?

It is the perpendicular distance from the root to the hypotenuse of the largest isosceles right-angled triangle that can be inscribed within the weld cross-section.

Throat thickness = 0.7 x size of the weld

29. What is plug weld and slot weld?

Slot weld is one of the type of weld used to join the two touching contiguous components by a fillet weld round the periphery of a slot in one component so as to join it the surface of other component.

Plug weld is made by filling in a hole in one part with filler metal so as to join it to the contiguous part exposed through a hole.

30. Mention the advantages and disadvantages of welded connections?

Disadvantages:

Requires skilled labour

Joints are over rigid

Difficult to inspect

31. State the common defects in welding Incomplete fusion

Incomplete penetration
Porosity Slag inclusions
CracksUnder cutting

32. Name the types of bolted connections?

Ordinary unfinished 0r black bolts Turned and fitted bolts

High strength bolts

33. Write the advantages of high strength bolts?

As there is no slip between the plates, the joint is rigid

Alternating loads cause little variation of the stresses in the bolts; hence fatigue strength is also high.

No shearing or bearing stresses occur in bolts.

High strength of the joint due to high frictional resistance is obtained.

34. Write down the interaction equation?

$$\frac{\sigma_{tf}^{2}}{\sigma_{tf,cal}} + \frac{\tau_{vf}^{2}}{\tau_{vf,cal}} \leq 1$$

35. How will you calculate the number of rivets?

$$n = \frac{P}{\text{strength of a rivet}} = \frac{P}{R}$$

where P is the pull or push carried by the member.

UNIT – II - TENSION MEMBERS

1. Tie member – Explain.

Tie member or a tension member is a structural element carrying an axial tensile force. For the tensile force to be axial it is necessary that the load be applied through centroid of the section of the member. But under axial tension the member gets straightened and eccentricity of the force decreases. The member is almost straight at the yield point and the distribution of the stress over the section becomes uniform.

2. How the tension members are classified?

It is classified according to its shape and size and it depends upon the type of structures. Wires and cables – Used in hoists, derricks, suspenders in suspension bridges

Rods and bars – Used in radio tower, small spanned roof trusses with different cross-sections such as round, rectangular or square

3. What is meant by single section member?

Structural sections such as I-section, T-section, angle, and channel are used as tension members. As the structural shapes provide more rigidity than cables or rods, their buckling tendency under compression load is reduced and so can be used where reversal of stress takes place.

4. Under what circumstances you would go for Built-up members?

When single structural sections fail to provide required strength and stiffness to carry tension as well as compression in case of reversal of stresses, built-up members are used.

5. How the tension members are selected?

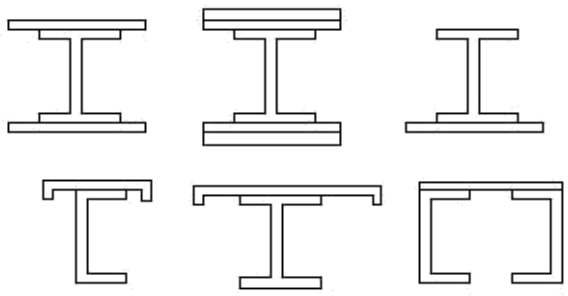
It depends upon the various factors such as type of fabrication, type of structure, type of loading, i.e. whether the member undergoes reversal of stresses, and the maximum tension to be carried by the member.

8. How is net effective area of single angle used as tension member calculated? Net effective area = $A_1 + A_2K$

A_1- Net area of connected leg

A_2- area of outstanding leg

$$K = \frac{3A_1}{3A_1 \square A_2}$$



9. What is net sectional area of a tension member? How it is calculated in chain riveting?

The gross sectional area of the tension member minus the sectional area of the maximum number of rivet/bolt holes is known as net sectional area.

In case of chain riveting, $a_{net} = (b - nd)\, t$

10. What is Lug angle?

A larger length of the tension member and the gusset plate may be required sometimes to accommodate the required number of connection rivets. But this may not be feasible and economical. To overcome this difficulty lug angles are used in conjunction with main tension members at the ends. It provides extra gauge lines for accommodating the rivets and thus enables to reduce the length of the connection. They are generally used when the members are of single angle, double angle or channel sections

11. What are the main objectives of the lug angles?

They produce eccentric connections, due to rivets placed along lug angle. The centroid of the rivet system of the connection shifts, causing eccentric connection

and bending moments. Stress distribution in the rivets connecting lug angles is not uniform. It is preferred to put a lug angle at the beginning of the connection where they are more effective and not at the middle or at the end of the connection. Rivets on the lug angles are not as efficient as those on the main member. The out-standing leg of the lug angle usually gets deformed and so the load shared by the rivets on the lug angles is proportionately less.

12. What is meant by Tension splice?

Splicing of tension members is necessary when the required length of the member is more than the length available or when the member has different cross-sections for different parts of its length. If actual member is to be of greater length, two or more lengths shall have to be spliced at the joints.

13. What is the net effective area of a pair of angles placed back to back connected by one leg of each angle subjected to tension?

$Anet = A_1 + A_2 K$

A_1 - effective cross – section area of connected legs

A_2 – Gross area of outstanding legs

$K = {}^{5A}1\ 5A_1 \square\ A$
^{2}

14. What is the permissible stress in axial tension?

As per IS: 800 – 1984, the permissible stress in axial tension $\sigma_{at} = 0.6\ f_y$ N/mm^2

f_y = minimum yield stress in steel in N /mm^2.

15. How will you join the member of different thickness in a tension member?

When tension member of different thickness are to be jointed, filler plates may be used to bring the member in level.

16. What happens when a single angle with one leg is connected to a gusset plate, which is subjected to an eccentric load?

The rivets connecting the angle to the gusset plate does not lie on the line of action of load. This gives rise to an eccentric connection due to which the stress distribution becomes non-uniform. The net cross-sectional area of such a section is reduced to account for this non-uniform stress distribution resulting from eccentricity.

17. What is the allowable stress in axial tension for channel section?

The allowable stress in axial tension for channel section is depends upon the diameter of the section

Diameter	$\sigma_{at} = 0.6\ f_y$ N/mm^2
Upto 20mm	150
20mm to 40 mm	144
Over 40 mm	138

18. What are tacking rivets? Why are they essential in compression members?

Rivets used to connect long length of members to reduce the effective length of individual part

19. Write down the Steinman's formula

$$A_{nert} = t\ (b - nd) \square\ m\frac{s}{4g}$$

Where n = no. of rivets in the section considered

m= no. of zig zags or inclined lines.

20. What will be the maximum pitch when the angles are placed back to back? The maximum pitch when the angles are placed back to back is 1mm.

UNIT – III - COMPRESSION MEMBERS

1. What do you mean by compression members?

Compression members are the most common structural elements and it is termed as columns, struts, posts or stanchions. They are designed to resist axial compression.

2. Name the modes of failures in a column.

Failure of the cross-section due to crushing or yielding

Failure by buckling, due to elastic instability

Mixed mode of failure due to crushing and buckling

3. Define slenderness ratio

It is defined as the ratio of effective length *l* of the column to the least radius of gyration *r* of the column section.

4. Classify the columns according to the slenderness ratios

Short columns - $l/r < 60$

Medium columns - $60 < l/r < 100$

Long columns - $l/r > 100$

5. Distinguish column and strut

Columns are the vertical members which carry the loads to the beams, slabs etc,

generally they are used in ordinary buildings.

Struts are commonly used for compression members in a roof truss; it may either be

in vertical position or in an inclined position.

6. What is meant by stanchions?

These are the steel columns made of steel sections, commonly used in buildings.

7. What is Post?

It is loosely used for a column, but in truss bridge girders, end compression members

are called end posts.

8. What is a boom?

It is the principal compression member in a crane.

9. State the assumptions that made in Euler's theory.

The axis of the column is perfectly straight when unloaded.

The line of thrust coincides exactly with the unstrained axis of the

strut. The flexural rigidity *EI* is uniform

The material is isotropic

10. Why the lateral systems are provided in compound columns?

If the plates are not connected throughout their length of the Built up sections, lateral systems may be provided, which act as a composite section. In such cases the load carrying elements of the built-up compression member in the relative position, without sharing any axial load. However when the column deflects, the lateral system carries the transverse shear force.

11. Name the lateral systems that are used in compound columns and which is the mostly used one?

Lacing or latticing, Battening or batten plates, perforated cover plates.

Lacing or latticing is the most common used lateral system and the sections are flats, angles and channels.

12. What will be the thickness for the single and double lacing bars?

The thickness of flat lacing bars shall not be less than one-fortieth of the length between the inner end rivets or welds for single lacing, and one-sixtieth of the length for double lacing.

13. What is the purpose of providing battens in compound steel columns?

Batten plates consist of flats or plates, connecting the components of the built-up columns in two parallel planes. These are used only for axial loading. Battening of the composite column should not be done if it is subjected to eccentric loading or a applied moment in the plane of battens.

14. What is the thickness of a batten plate?

The thickness of batten plate shall not be less than one fiftieth of the distance between the inner most connecting lines of rivets or welds. This requirement eliminates lateral buckling of the batten.

15. Where the perforated cover plates are used and mention its advantages?

They are mostly used in the box sections, which consist of four angle sections so that the interior of column remains accessible for painting and inspection.

Advantages:

They add to the sectional area of column and the portions beyond the perforation share axial load to the extent of their effective area.

There is economy and fabrication and maintenance

Perforations conveniently allow the riveting and painting work on the inside portion.

16. Name the types of column base?

Slab Base, which is a pinned base.

Gusseted base, which is a rigid base.

17. State the purpose of column base?

The base of the column is designed in such a way to distribute the concentrated column load over a definite area and to ensure connection of the lower column end to the

foundation. It should be in adequate strength, stiffness and area to spread the load upon the concrete or other foundations without exceeding the allowable stress.

18. Give the difference between slab base and gusseted base for steel columns.

Slab base is a thick steel base plate placed over the concrete base and connected to it through anchor bolts. The steel base plate may either be shop-welded to the stanchion, or elsecan be connected at the site to the column through cleat angles. The column is faced for bearing over the whole area.

In a gusseted base, part of the load is transmitted from the stanchion through the gusseted base plate. The gussets and stiffeners support the base slab against bending and hence a thinner base plate can be used. The gussets serve for more or less uniform transmission of the force field from the column to the base plate. The gussets itself resists the bending as double cantilever beam supported on flanges of the column.

19. What is slab base and for what purpose is it provided?

The base plate connected to the bottom of the column to transfer over wider area is known as slab base. Column end is machined to transfer the load by direct bearing. No gusset materials are required.

20. When the slenderness ratio of compression member increases, the permissible stress decreases. Why?

The section must be so proportioned that it has largest possible moment of inertia for the same cross-sectional area. Also the section has approximately the same radius of gyration about both the principal axes.

BEAMS

1. What is a beam?

A beam is a structural member, which carries a load normal to the axis. The load produces bending moment and shear force in the beam.

2. What is meant by castellated beam?

A rolled beam with increased depth is to be castellated. To obtain such sections, a zigzag line is cut along the beam by an automatic flame-cutting machine. The two halves thus produced are rearranged so that the teeth match up and the teeth are then welded together.

3. How the beams are failed?

Bending failure

Shear failure

Deflection failure

The designs are based on these three failures which are to be determined.

4. What do you mean by bending failure?

Bending failure may be due to crushing of compression flange or fracture of the tension flange of the beam. Instead of failure due to crushing, the compression flange may

fail by a column like action with side ways or lateral buckling. Collapse would follow the lateral buckling.

5. What is the maximum deflection that to be allowed in steel beams?

   The deflection of a member, shall not be such as to impair the strength or efficiency of the structure and lead to finishing. The deflection is generally should not exceed 1/325 of the span.

6. What is web crippling?

   Web crippling is the localized failure of a beam web due to introduction of an excessive load over a small length of the beam. It occurs at point of application of concentrated load and at point of support of a beam. A load over a short length of beam can cause failure due to crushing and due to compressive stress in the web of the beam below the load or above the reaction. This phenomenon is also known as web crippling or web crushing.

7. What are laterally supported beams?

   The beams which are provided with the lateral supports either by embedding the compression flange in the concrete slab or by providing effective intermediate (support) restraints at a number of points to restrain the lateral buckling is called laterally supported beams.

8. Mention the advantages of using rolled steel wide flange section as beams More section modulus

   Lesser area

   Economical

9. Why does buckling of web occur in beams?

   Diagonal compression due to shear

   Longitudinal compression due to bending

   Vertical compression due to concentrated loads

10. What are the permissible stresses used in the beams?

    The permissible stresses, which are used in the beams are bending and shear stress.

Bending Stress

For laterally supported beams,

$$\sigma_{bt} \text{ or } \sigma_{bc} \leq 0.66 f_y$$

For laterally unsupported beams,

$$\sigma_{bc} \leq 0.66 \frac{f_{cb} \cdot f_y}{\left[(f_{cb})^n + (f_y)^n\right]^{1/n}}$$, Where n is assumed to be 1.4

Shear Stress

$\tau_{vm} \leq 0.45 f_y$, τ_{vm} = maximum permissible shear stress

11. Under what situations the plated beams are used?

    When a bending moment is large which cannot be resisted by the largest available rolled beam section

The depth of the beam is restricted due to headroom requirements.

12. Why intermediate stiffeners are required for plate girders?

The web of the plate girder relatively being tall and thin it is subjected to buckling. Hence it is stiffened both vertically and horizontally using intermediate stiffeners.

13. What do you mean by curtailment of flanges?

The section of a plate girder is to be designed first at mid span. The bending moment will goes on decreasing towards the supports. Hence the flange plates, provided at the maximum section can be curtailed.

14. What is the purpose of providing the bearing stiffener?

It prevents the web from crushing and buckling sideways, under the action of concentrated loads

It relieves the rivets connecting the flange angles and web, from vertical shear.

15. Name the components of a plate girder.

Web plate	Vertical or transverse stiffeners
Flange plate	Bearing stiffeners
Flange angles	Longitudinal or horizontal stiffeners
Web splice plates	End bearings or end connections
Flange splice plates	

16. Mention the basic design assumptions of a plate girder?

The web plate resists the shear force.

The shear stress is uniformly distributed over whole cross sectional area of web. The flanges resist the bending moment

17. Where the plate girders are used?

The plate girders are used in the buildings where the span is more and heavy loads are expected and in the bridges. Most commonly they are used in the bridges.

18. What are the methods that are adopted to determine the flange design?

Flange area method Moment of inertia method

The former method is an approximate method, which is used for determining the trial section. In this method, it is assumed that the stress distribution in the tension and compression flanges is uniform, whereas in the latter case it is the exact method and is recommended by the IS code. Generally, the section designed by the flange area method is checked by this method.

19. What is the economical depth of a plate girder?

The economical depth of a plate girder is

$$d = 1.1\sqrt{\frac{M}{\sigma_{bc} t_w}}$$

where σ_{bc} = permissible bending stress in compression in N/mm^2.

t_w = thickness of the web plate.

20. The pitch of the rivets connecting cover plates with flanges of rolled steel beam is designed for what force?

These rivets are designed for horizontal shear between the flange plate and flange angles. Since the vertical load is transferred by the flange plates to the flange angles by direct bearing, there will be no vertical shear due to the vertical load. Here the rivets will be in single shear.

UNIT – V – ROOF TRUSSES AND INDUSTRIAL BUILDINGS

1. Name the types of roofing systems.

   Flat roofing consists of either RCC construction or RSJ slab construction Sloping roofing

2. Where the steel roof trusses are used?

   Industrial buildings, workshop buildings, storage godowns, warehouse and even for residential buildings, school buildings, offices where the construction work is to be completed in a short duration of time.

3. Mention the advantages of a roof truss.

   Its mid-span depth is the greatest specially where bending moment in the span is the maximum Great economy.

   Sloping faces of trusses facilitate in easy drainage of rainwater.

4. What is the factor that is considered in the roof truss and why?

   The factor, which is considered in the roof truss, is pitch, it is defined as the ratio of

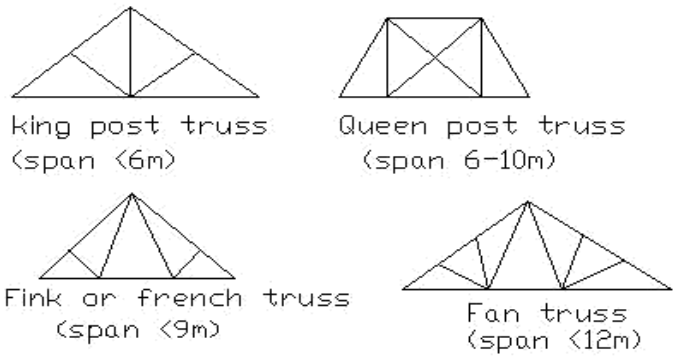
   the span length to the depth of the truss, is governed by the roofing material and other

   requirements such as ventilation and light.

5. How the trusses are classified according to the pitch?

Small pitch	- span depth ratio is more than 12 m
Medium pitch	- span depth ratio is between 5m to 12 m
Large pitch	- span depth ratio is 5 or less.

6. Sketch the various types of roof truss.



7. Name the components of a roof truss. Principal rafter or top chord

   Bottom chord or main tie

   Ties

   Struts

   Ridge line

   Eaves

   Panel points

   Roof coverings

Sag tie

Purlins

Rafters

Shoe angle

Base plate, anchor plate and anchor bolts

8. What is gantry girder and what are the forces that are acting on it?

A gantry girder, having no lateral support in its length, has to withstand vertical loads from the weight of the crane, hook load and impact and horizontal loads from crane surge.

9. What is meant by purlins?

Purlins are structural members which are supported on the principal rafter, and which run transverse to the trusses. The span of the purlins is equal to the center-to-center spacing of the trusses. The purlins support the roof covering either directly or through common rafters. They are usually made of either an angle section or a channel section and are therefore subjected to unsymmetrical bending.

10. Why the bracings are provided?

Bracing is required to resist horizontal loading in pin-jointed buildings, including roof trusses. Bracing of roof trusses and supporting columns provide still rigid structure. When wind blows normal to the inclined surface of the trusses, it is efficiently resisted by all the members of the truss and the wind forces are transferred to the supports at the ends of the truss.

11. Name the most common roof covering materials.

Slates	Glass
Tiles	Corrugated aluminium sheets
Lead sheets	Galvanized corrugated iron sheets (G.I. sheets)
Zinc sheets	Asbestos cement sheets (A.C. sheets)

12. Write the equation to calculate the design wind pressure.

Design pressure is $p = 0.6 V_z^2$

$V_z = V_b k_1 k_2 k_3$

V_b = Basic wind speed in m/s at 10 m height

k_1 = Probability factor (or risk coefficient)

k_2 = Terrain, height and structure size factor

k_3 =Topography factor

13. Mention some of the requirements of a good joint.

The line of thrust should pass through the C.G of the rivet group and the rivets should be symmetrically arranged about this line.

For a tension member, the rivets should be so arranged that the area of the member joined is not reduced more than necessary.

The number and the diameter of rivets should be sufficient to develop the maximum stresses induced in all the members at the connection.

Members should be straight and bolts used to draw them together before the rivets are driven.

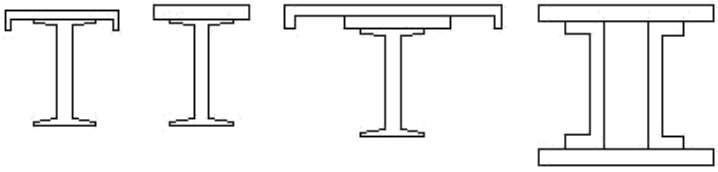
14. What are the conditions that to be satisfied for the end supports?

The size of base plate should be sufficient so that the bearing pressure does not exceed the permissible value. Anchor bolts should be provided at one end to accommodate the thermal expansion of the truss. The lines of forces in rafter, bottom tie and vertical end reaction meet at a point.

15. Where the gantry girders are used?

Gantry girders or crane girders carry hand operated or electric over head cranes in industrial buildings such as factories, workshops, steel works etc., to lift heavy materials, equipment etc., to carry them from one location to the other, within the building.

16. Sketch the various forms of gantry girders.



Forms of gantry girders

17. What is drag force?

This is caused due to the starting and stopping of the crane bridge moving over the crane rails as the crane m0oves longitudinally, i.e. in the direction of gantry girders.

18. What is the permissible deflection where the electrically overhead cranes operated over 500kN?

The maximum vertical deflection for crane girder, under dead and imposed loads shall not exceed L/1000, where L is the span of the crane runway girder.

19. Define shoe angle.

It is a supporting angle provided at the junction of the top and bottom chords of a truss. The reaction of the truss is transferred to the supports through the shoe angle. It is supported on the base plate.

20. What is panel point?

These are the prominent points along the principal rafter, at which various members (i.e. ties and struts) meet. The distance of the principal rafter between any two panel point is termed as panel.