QUESTION BANK

DESIGN OF STEEL STRUCTURES

1. Distinguish between gauge distance and pitch of the bolt.

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.

Pitch distance

It is the center to center spacing of the bolts in a row, measured along the direction of load.

2. What are the merits and demerits of welded connection?

Merits

- Due to absence of gusset plates, connecting angles etc., welded structures are lighter.
- Welding is more adaptable than bolting or riveting. For example, even circular tubes can be easily connected by welding.
- Welded joints are rigid.

Demerits

- Due to uneven heating and cooling, members are likely to distort in the process of welding.
- Welded joints are over rigid.
- Proper welding in field conditions is difficult.

3. What is bolt value?

The strength of the bolted connection is called as a bolt value. The bolt value is calculated in the design of bolted connection with their strength in various considerations.

4. List out the disadvantages of welded connections.

Due to uneven heating and cooling, members are likely to distort in the process of welding.

Welded joints are over rigid.

Proper welding in field conditions is difficult.

There is a greater possibility of brittle fracture in welding.

Highly skilled person is required for welding.

The inspection of welded joints is difficult.

4. **Define pitch of the rivet.**

It is the center to center spacing of the rivets in a row, measured along the direction of .

5. **What do you mean by splitting of plates?**

Splitting of plates is defined as the plates are spitted by the design of the required joint strength.

6. **Define bolt.**

Bolt is a metal pin with a head formed at one end and the shank threaded at the other to receivea nut.

7. **List out the various types of welded joints.**

- Butt weld
- Fillet weld
- Slot weld
- Spot weld
- Seam weld
- Pipe weld

8. **Define modulus of elasticity.**

The modulus of elasticity is defined as the ratio of longitudinal strain with the elastic region, it is denoted by E.

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

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

10. **Define nominal diameter of rivet.**

It is the diameter of the unheated rivet measured before driving. It is the stated diameter of the rivet, available in the market.

11. **Define gross diameter of rivet.**

It is the diameter of the rivet in the hole, measured after driving. It is taken equal to the diameter of the rivet hole.

12. **What is meant by gauge distance and edge distance?**

Gauge distance is the perpendicular distance between two adjacent gauge lines. This is also called as back pitch. Edge distance is the distance of the edge of the member or the cover plates from the centre of extreme rivet hole.

13. Define staggered pitch.

It is also called as alternate pitch or reeled pitch. The staggered pitch is defined as the distance measured along one rivet line from the centre of a rivet to the centre of the adjoining rivet on the adjacent parallel rivet line.

14. What is meant by tensile stress?

When a structural member is subjected to direct axial tensile load, the stress is known as tensile stress (σ_{at}). The tensile stress is calculated on net cross-sectional area of the member.

$$\sigma_{at} = (P_t / A_n)$$

Where, P_t is the direct axial tensile load and A_n is the net cross-sectional area of the member.

15. What is meant by compressive stress?

When a structural member is subjected to direct axial compressive load, the stress is known as compressive stress (σ_{ac}). The compressive stress is calculated on gross cross- sectional area of the member.

$$\sigma_{ac} = (P_c / A_g)$$

Where, P_c is the direct axial compressive load and A_g is the gross-sectional area of the member.

16. Define bearing stress.

When a load is exerted or transferred by the application of load through one surface for another surface in contact, the stress is known as bearing stress (σ_p). the bearing stress is calculated on net projected area of contact.

$$\sigma_p = (P / A)$$

Where, P = load placed on the bearing surface.

A = net projected area of contact.

17. What is working stress?

The working stress is also termed as allowable stress or permissible stress. The working stress is evaluated by dividing yield stress by factor of safety. For the purpose of computing safe load carrying of a structural member, its strength is expressed in terms of working stress. The actual stresses resulting in a structural member from design loads should not exceed working stress.

18. What are the assumptions made in simple design?

- The beams are simply supported.
- All connections of beams, girders, or truss are virtually flexible and are proportioned forthe reaction shears applied at the appropriate eccentricity

- The members in compression are subjected to forces applied at the appropriate eccentricities.
- The members in tension are subjected to longitudinal forces applied over the net area of the sections.

19. What are the types of riveted joints?

i. Lap joint
   (a) Single riveted lap joint
   (b) Double riveted lap joint

ii. Butt joint
   (a) Single cover butt joint
   (b) Double cover butt joint

20. What are the types of failures occur in 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.

21. What are the assumptions made for designing riveted joint?

- The load is assumed to be uniformly distributed among all the rivets.
- The shear stress on a rivet is assumed to be uniformly distributed over its gross area.
- The bearing stress is assumed to be uniform between the contact surfaces of plate and rivet.
- The bending stress in a rivet is neglected.
- The rivet hole is assumed to be completely filled by the rivet
- The stress in plate is assumed to be neglected.
- The friction between plates is neglected.

22. Write about minimum pitch and maximum pitch.

Minimum pitch: The distance between centers of adjacent rivets should not be less than 2.5 times the gross diameter of the rivet.

Maximum pitch:

- The maximum pitch should not exceed 12t or 200 mm whichever is less in case of

compression member, and 16t or 300 mm whichever is less in case of tension member.

- The distance between centres of any two consecutive rivets in a line adjacent and parallel to an edge of an outside plate shall not exceed (100mm + 4t) or 200 mm, whichever is less in compression or tension members.
- If the line of rivets (including tacking rivets) does lie in the direction of stress, the maximum pitch should not exceed 32 t or 300 mm whichever is less, where t is the thickness of the thinner outside plate.

23. What is edge distance?

A minimum edge distance of approximately 1.5 times the gross diameter of the rivetmeasured from the centre of the rivet hole is provided in the rivet joint.

24. 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

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

- Unfinished bolts
- Turned bolts
- High strength bolts

26. Give the properties of steel.
27. Draw the structural steel sections.
28. Give the limit state design concepts.

29. What are the loads on structural steel?

30. Find the maximum force which can be transferred through the double covered butt joint shown in fig.

Find the efficiency of the joint also. Given M20 bolts of grade 4.6 and Fe410 steel plates are used.

31. Two cover plates, 10mm and 18mm thick are connected by a double cover butt joint using 6mm cover plates as shown in fig. Find the strength of the joint. Given M20 bolts ofgrade 4.6 and Fe410 plates are used.

32. Find the efficiency of the lap joint shown in fig.1.with the following data: M20 bolts of Grade 4.6 and Fe410 plates are used

33. Design a lap joint between the two plates each of width 120mm,if the thickness of one plate is 16mm and the other is 12mm.the joint has to transfer a design load of 160Kn.the plates are of Fe410grade.use bearing type bolts.

34. Design a single bolted double cover butt joint to connect boiler plates of thickness 12mm for maximum efficiency. Use M16 bolts of grade 4.6.boiler plates are of Fe 410 grade. Find the efficiency of the joint.

35. A bracket bolted to a vertical column is loaded as shown in fig. If M20 bolts of grade 4.6 are used, determin**e** the maximum value of factored load P which can be carried safely.

36. A bracket is bolted to the flange of a column as shown in fig. Using 8mm thick bracket plate. Using M20 bolts of grade 4.6 design the connection.

37. Design a suitable longitudinal fillet welds to connect the plates as shown in fig. To transmit a pull equal to the full strength of small plate. Given: plates are 12mm thick, grade of plates Fe410 and welding to be made in workshop.

38. A tie member of a roof truss consists of 2 ISA 10075, 8mm.the angles are connected to either side of a 10mm gusset plates and the member is subjected to a working pull of 300Kn.design the weld connection. Assume connections are made in the workshop.

39. Design a welded connection to connect two plates of width 200mm and thickness 10mm for 100 percent efficiency.

40. A tie member consists of two ISMC 250.the channels are connected on either side of a 12mm thick gusset plate.

41. Design the welded joint to develop the full strength of the tie. However the overlap is to be limited to 400mm.Determine the maximum load that can resist by the bracket shown in fig. By fillet weldof size 6mm, if it is shop welding.The 10mm thick bracket plate shown in fig. Is connected with the flange of columnISHB 3002577N/mm. find the size of the weld to transmit a factored load of 250kN

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

Riveted connections

Bolted connections

Pin connections

Welded connections

43. **Define nominal diameter of rivet.**

It is the diameter of the unheated rivet measured before driving. It is the stated diameter of the rivet, available in the market.

44. Define gross diameter of rivet.

It is the diameter of the rivet in the hole, measured after driving. It is taken equal to the diameter of the rivet hole.

45. What is meant by gauge distance and edge distance?

Gauge distance is the perpendicular distance between two adjacent gauge lines. This is also called as back pitch.

Edge distance is the distance of the edge of the member or the cover plates from the centre of extreme rivet hole.

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47. What is meant by tensile stress?

When a structural member is subjected to direct axial tensile load, the stress is known as tensile stress The tensile stress is calculated on net cross-sectional area of the member.

$a_t = (P_t / A_n)$

Where, P_t is the direct axial tensile load and A_n is the net cross-sectional area of the member.

48. What is meant by compressive stress?

When a structural member is subjected to direct axial compressive load, the stress is known as compressive stress (ac). The compressive stress is calculated on gross cross-sectional area of the member.

$a_c = (P_c / A_g)$

Where, P_c is the direct axial compressive load and A_g is the gross-sectional area of the member.

49. Define bearing stress.

When a load is exerted or transferred by the application of load through one surface for another surface in contact, the stress is known as bearing stress (p). the bearing stress is calculated on net projected area of contact.

$p = (P / A)$

Where, P = load placed on the bearing surface.

A = net projected area of contact.

50. What is working stress?

The working stress is also termed as allowable stress or permissible stress. The working stress is evaluated by dividing yield stress by factor of safety. For the purpose of computing safe load carrying of a structural member, its strength is expressed in terms of working stress. The actual stresses resulting in a structural member from design loads should not exceed working stress.

51. What are the methods employed for the design of the steel framework?

Simple design

Semi-rigid design

Fully rigid design

Plastic design.

52. What are the assumptions made in simple design?

The beams are simply supported.

All connections of beams, girders, or truss are virtually flexible and are proportioned for the reaction shears applied at the appropriate eccentricity

The members in compression are subjected to forces applied at the appropriate eccentricities.

The members in tension are subjected to longitudinal forces applied over the net area of the sections.

53. Define Poisson's Ratio.

The Poisson's ratio is defined as the ratio of transverse strain to the longitudinal strain under an axial load. It is denoted by 'μ' or 1/m. the value of Poisson's ratio for steel within the elastic region ranges from 0.25 to 0.33.

54. What are the types of riveted joints?

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Single riveted lap joint

Double riveted lap joint

Butt joint

Single cover butt joint

Double cover butt joint

55. What are the types of failures occur in riveted joint?

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Shear failure of plates

Tearing failure of rivets

Bearing failure of plates

Splitting failure of plates at the edges

Bearing failure of rivets.

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The bending stress in a rivet is neglected.

The rivet hole is assumed to be completely filled by the rivet

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The friction between plates is neglected.

57. Write about minimum pitch and maximum pitch.

Minimum pitch: The distance between centres of adjacent rivets should not be less than 2.5 times the gross diameter of the rivet.

Maximum pitch:

The maximum pitch should not exceed 12t or 200 mm whichever is less in case of compression member, and 16t or 300 mm whichever is less in case of tension member.

The distance between centres of any two consecutive rivets in a line adjacent and parallel to an edge of an outside plate shall not exceed (100mm + 4t) or 200 mm, whichever is less in compression or tension members.

If the line of rivets (including tacking rivets) does lie in the direction of stress, the maximum pitch should not exceed 32 t or 300 mm whichever is less, where t is the thickness of the thinner outside plate.

58. What is edge distance?

A minimum edge distance of approximately 1.5 times the gross diameter of the rivet measured from the centre of the rivet hole is provided in the rivet joint.

59. 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

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

Unfinished bolts
Turned bolts

High strength bolts

61.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

62. List the various types of welded joints.

Butt weld

Fillet weld
Slot weld and plug weld

Spot weld
Seam weld

Pipe weld

63 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.

64 What is the effective area of butt weld?

The effective area of a butt weld is taken as the product of the effective throat thickness and the effective length of butt weld.

65. How the length of bolt is calculated?

The length of bolt is equal to the distance from the underside of the bolt head to the extreme end of the shank, including any camber or radius.

66. A double riveted double cover butt joint is used to connect plates 12 mm thick. Using Unwin's formula, determine the diameter of rivet; rivet value, gauge and efficiency of joint. Adopt the following stresses: Working stress in shear in power driven rivets = 100 N / mm^2 (Mpa) Working stress in bearing in power driven rivets = 300 N / mm^2 (Mpa) Working stress in axial tension in plates = 0.6 f_y

67. Determine the strength of a double cover butt cover butt joint used to connect two flats 200 F 12. The thickness of each cover plate is 8 mm. flats have been joined by 9 rivets in chain riveting at a gauge of 60 mm. What is the efficiency of the joint? Adopt working stresses in rivets and flats .

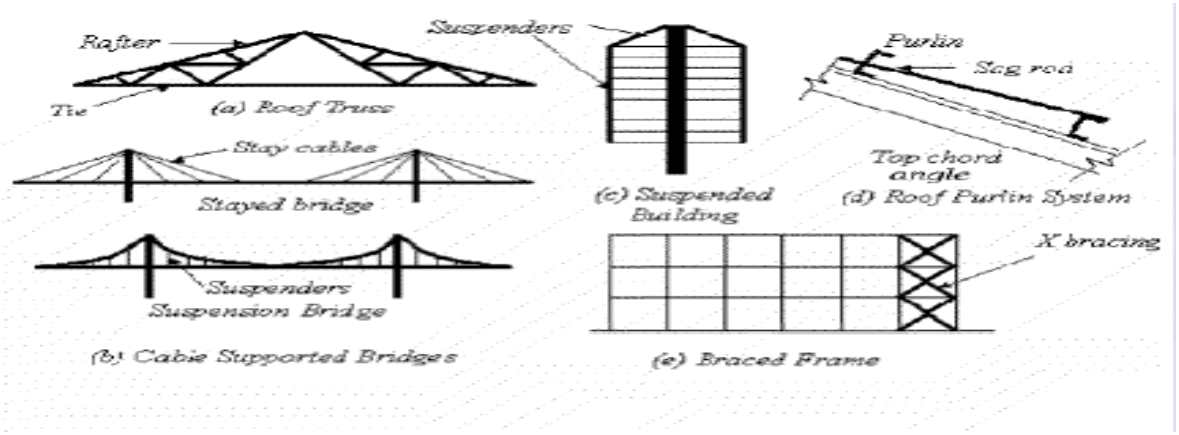
68. A load of 150 kN is applied to a bracket plate at an eccentricity of 300 mm. sixteen rivets of 20 mm nominal diameter are arranged in two rows with 8 rivets per row. The two rows are 200 mm apart and the pitch is 80 mm. if the bracket plate is 12.5 mm thick, investigate the safety of the connection. Given, s = 100 N / mm^2,
f_b = 300 N / mm^2 and f_t = 150 N / mm^2.

69. A bridge truss carries an axial pull of 400 KN. It is to be a gusset plate 22mm thick by a double cover butt joint with 22 mm diameter power driven rivets. Design an economical joint. Determine the efficiency of the joint.

70. What are the types of load to be account for steel design

71. Explain the tension member.

Tension members are linear members in which axial forces act so as to elongate (stretch) the member. A rope, for example, is a tension member. Tension members carry loads most efficiently, since the entire cross section is subjected to uniform stress.Unlike compression members, they do not fail by buckling.



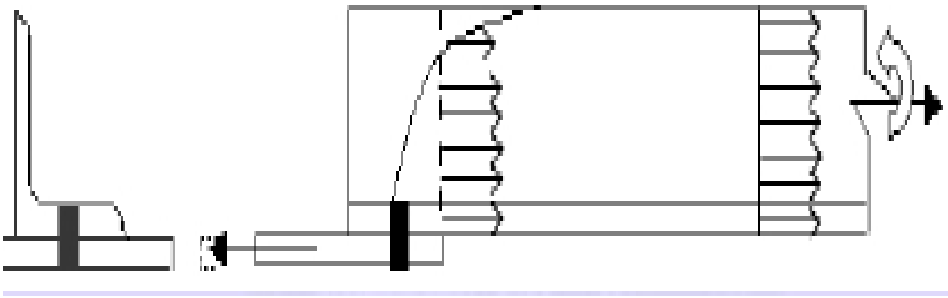
72. Explain Behavior of tension members

Since axially loaded tension members are subjected to uniform tensile stress, Their load deformation behavior (is similar to the corresponding basic material stress strain behaviour. In the Yield Plateau the load remains constant as the elongation increases to nearly ten times the yield strain. Under further stretching the material shows a smaller increase in tension with elongation, compared to the elastic range.

73. Write note on Load-elongation of tension member

Angles under tension, Angles are extensively used as tension members in trusses and bracings. Angles, if axially loaded through centroid, could be designed as in the case of plates .However, usually angles are connected to gusset plates by bolting or welding only one of the two legs

This leads to eccentric tension in the member, causing non-uniform Distribution of stress over the cross section. Further, since the load is applied by Connecting only one leg of the member there is a shear lag locally at the end Connections



74. How Angle sections eccentrically loaded through gussets plate?

• The effect of the gusset thickness, and hence the out of plane stiffness of the end connection, on the ultimate tensile strength is not significant.

• The thickness of the angle has no significant influence on the member strength.

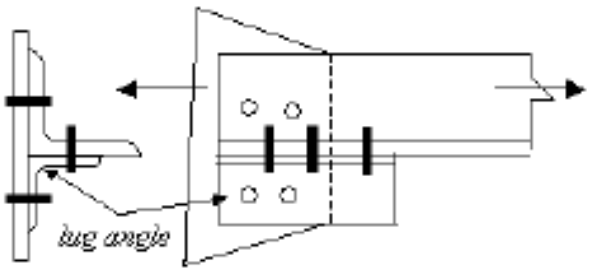
• The effects of shear lag, and hence the strength reduction, is higher when the ratio of the area of the outstanding leg to the total area of cross-section increases.

• When the length of the connection (the number of bolts in end connections) increases, the tensile strength increases up to 4 bolts and the effect of further increase in the number of bolts, on the tensile strength of the member is not significant. hnology

• Even double angles connected on opposite sides of a gusset plate experience the effect of shear lag

75. What is a Lug angle?

In order to increase the efficiency of the outstanding leg in single angles and to decrease the length of the end connections, some times a short length angle at the ends are connected to the gusset and the outstanding leg of the main angle directly, as shown in Fig.. Such angles are referred to as lug angles.



Tension member with lug angle

76. Why Stiffener required in tension members?

The tension members, in addition to meeting the design strength requirement, Frequently have to be checked for adequate stiffness. The IS: 800 impose the following limitations on the slenderness ratio of members subjected to tension:

(a) In the case of members that are normally under tension but may experience compression due to stress reversal caused by wind / earthquake loading l / r =250 .

(b) In the case of members that are designed for tension but may experience stress reversal for which it is not designed (as in X bracings) l / r =350

(c) In the case of members subjected to tension only. l / r = 400 In the case of rods used as a tension member in X bracings, the slenderness ratio limitation need not be checked for if they are pre-tensioned by using a turnbuckle or other such arrangement.

77. Different types of tension members?

i) Wires and cables
ii) Rods and bars
iii) Single structural shapes and plates
iv) Built-up members

78. Write note on tension member splice

When a joint is to be provided in a tension member, then splice plates are used. Splice plates and rivets are designed for the pull required to be transmitted by the tension member. If the tension members are of unequal thickness, then, packing are used to have surfaces of tension members in one level.

79. What do you understand by Gross area and Net Area?

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

Net area (A_n) : Net area is equal to the gross area less the area due to holes in the cross section.

$A_n = A_g$ – area of rivet holes in line.

80. A tie of a roof truss consists of double angles ISA 100X75X10 mm with its short legs back to back and long legs connected to the same side of a gusset plate, with 16mm diameter rivets. Determine the strength of tie in axial tension, taking f_t = 150 N/mm^2. take rivets have been provided at suitable pitch.

Dia of rivet hole = 16 + 1.5 = 17.5mm

Each angle is weakened by one rivet hole. Hence this is case 2, where A_{net} =

A_1+A_2k and

$k = 5A_1/5A_1+A_2$

A_1 = Net area of connected legs= 2 [100 – 10/2 – 17.5] X 10 = 1550mm^2

A_2 = area of connected legs = 2[75 – 10/2]X 10 = 1400mm^2 k

=5X1550/5X1550 X1400= 0.847

$A_{net} = A_1+A_2k$ = 1550 + 1400X0.847 = 2736mm^2

Strength = f_t X A_{net} = 150X2736 = 410369N.

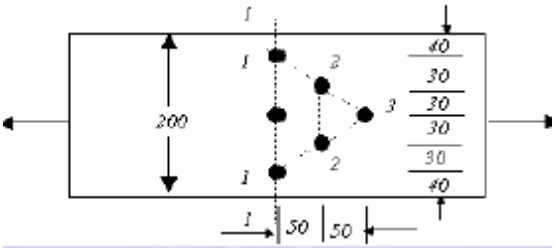
81. Using a lug angle, design a suitable joint for 100 mm * 65mm *10 mm angle, used as a tension member .use 20 mm diameter rivets and thickness of gusset plate 8 mm.The bottom tie of roof truss is 4m long .in addition to an axial tension of 1000 KN,it has to support at its centre a shaft of load of 3600N. The member is composed of two angles 100 mm * 75 mm* 10 mm with the longer legs turned down and placed back to back on either side of 10

mm gusset plate. The angles are tack riveted at 92 cm centres with 20 mm diameter rivets.

82. Design a horizontal tension member carrying a load 600 KN, The length of the member is 3 mm. The member is connected to 4.5 cm thick gusset plate 20 mm rivets. Design a tension member of heavy truss carrying a force of 4400 KN ,length of the member being 10 metres.

83. A bridge truss diagonal carries an axial pull of 300 KN .two mild steel flats 250 ISF 10 and ISF 18 of the diagonal are to be jointed together. Design a suitable splice

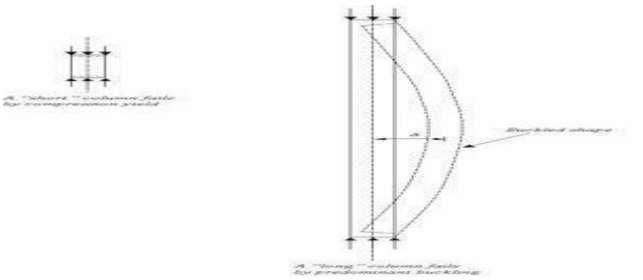
84. Determine the design tensile strength of the plate (200 X 10 mm) with the holes as Shown below, if the yield strength and the ultimate strength of the steel used are 250 MPa and 420 MPa and 20 mm diameter bolts are used.fy = 250 Mpa;fu = 420 MPa



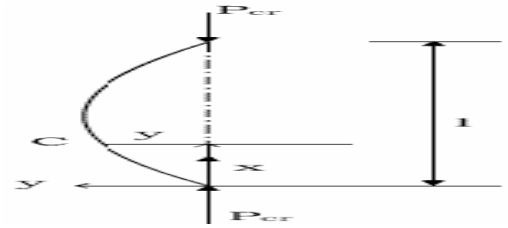
85. What is meant by short strut?

If the strut is "short", the applied forces will cause a compressive strain, which results in the shortening of the strut in the direction of the applied forces.

86. Draw the diagram of buckling of column



87. What are the assumptions made in Euler's analysis?



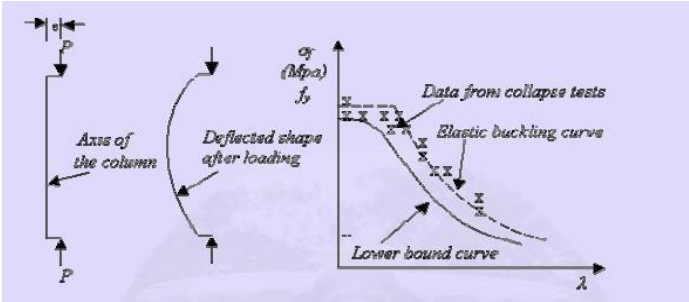
1. The material is homogeneous and linearly elastic (i.e. it obeys Hooke's Law).
2. The strut is perfectly straight and there are no imperfections.
3. The loading is applied at the centroid of the cross section at the ends.

88. What are the effect of strain hardening and the absence of clearly defined yieldpoint?

If the material of the column shows strain hardening after a yield platen, the on set of first yield will not be affected, but the collapse load may be increased. Designers tend to ignore the effect of strain hardening which in fact provides an additional margin of safety. High strength steels generally have stress-strain curves without a clear yield point. At stresses above the limit of proportionality (fp), the material behaviour is non-linear and on unloading and reloading the material is linear-elastic. Most high

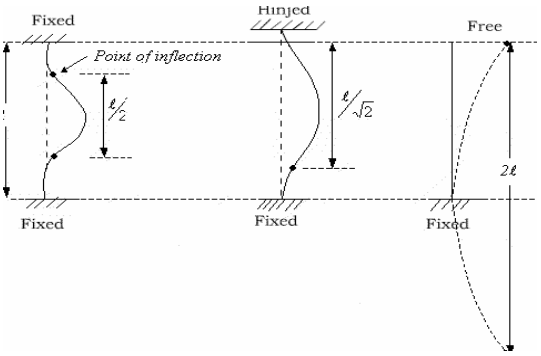
strength structural steels have an ultimate stress beyond which the curve becomes more or less horizontal.

89. Write the effect of eccentricity of applied loading



As has already been pointed out, it is impossible to ensure that the load is applied at the exact centroid of the column. Fig. shows a straight column with a small eccentricity (e) in the applied loading. The applied load (P) induces a bending moment (P.e) at every cross section. This would cause the column to deflect laterally,in a manner similar to the initially deformed member discussed previously. Once againthe greatest compressive stress will occur at the concave face of the column at a section midway along its length. The load-deflection response for purely elastic andelastic-plastic behaviour is similar to those described in Fig. except that the deflection is zero at zero load.

90. What are the buckled modes for different end conditions?



91.What are the different effective lengths for different boundary condition?

Boundary conditions	Theory	Code value
Both ends pin ended	1.0L	1.0L
Both ends fixed	0.5L	0.65L
One end fixed and the other end pinned	0.707L	0.8L

One end fixed, and the other free to sway	1.2L	1.2L

One end fixed and the other end free	2.0L	2.0L

92. What is meant by flexural buckling and torsional –flexural buckling?

When the strut buckles b jy bending in a plane of symmetry of the cross section, referred to as **"flexural buckling"**. Singly symmetric or un-symmetric cross-sections may undergo combined twistingabout the shear centre and a translate jon of the shear centre. This is known as **"torsional**– flexural buckling".

93. What are Steps in the design of axially loaded columns?

The procedure for the design of an axially compressed column is as follows:

(i) Assume a suitable trial section and classify the section in accordance with the classification in chapter.

(ii) Arrive at the effective length of the column by suitably considering the end conditions.

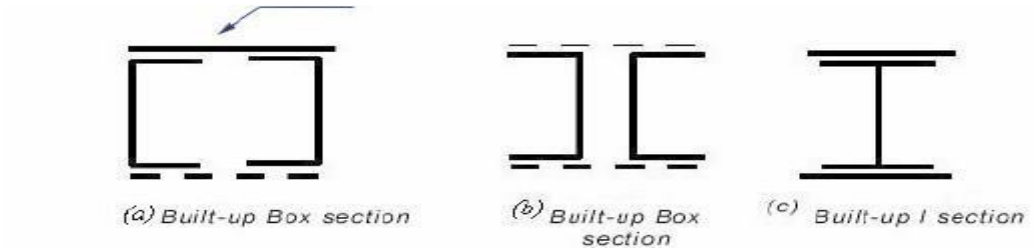
(iii) Calculate the slenderness ratios (λ values) in both minor and major axes direction

(iv) Calculate fcd values along both major and minor axes

(v) Compute the load that the compression member can resist ($pd=A_c f_{cd}$)

94. Write about batten plates compression member.

When compression members are required for large structures like bridges, it willbe necessary to use built-up sections. They are particularly useful when loads are heavy and members are long (e.g. top chords of Bridge Trusses). Built up sections [illustrated in Fig.] are popular in India when heavy loads are encountered. The cross section consists of two channel sections connected on their open sides with some type of lacing or latticing (dotted lines) to hold the parts together and ensure that they act together as one unit. The ends of these members are connected with "batten plates" which tie the ends together.



95. What are the three classifications for determination of size of plate?

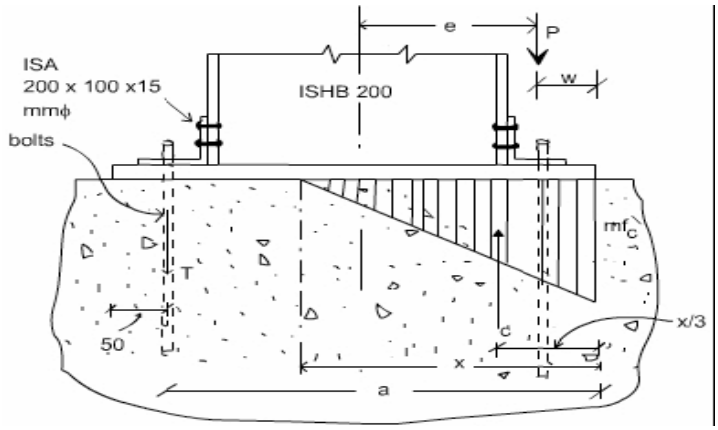
Class I- will pertain to all base plates the moment on which is so small in proportion to the direct load that there is compression over the entire area between the

bottom of the base and its foundation

Class II- will pertain a comparatively small range of base plates which have tension over a small portion - one - third or loss of the area

Class III- will include those which are exposed to a comparatively large moment and which therefore have tension over a large portion - more than one -third of the area between the bottom of the base plate and its concrete footing.

96. Draw the column base plate diagram



97. What is the purpose for providing anchors bolt in base plate?

Anchor bolts are provided to stabilize the column during erection and to prevent uplift for cases involving large moments. Anchor bolts can be cast-in place bolts or drilled-in bolts. The latter are placed after the concrete in set and are not too often used. Their design is governed by the manufacturer's specifications. Cast-in-place bolts are hooked bars, bolts, or threaded rods with nuts (figure) placed before the concrete is set.

98. What are main benefits of using composite floors with profiled steel decking?

i. Savings in steel weight are typically 30% to 50% over non-composite Construction

ii. Greater stiffness of composite beams results in shallower depths for the same span. Hence lower storey heights are adequate resulting in savings in cladding costs, reduction in wind loading and savings in foundation costs.

iii. Faster rate of construction.

99. Explain about the importance of steel decking.

- It supports loads during construction and acts as a working platform
- It develops adequate composite action with concrete to resist the imposed loading
- It transfers in-plane loading by diaphragm action to vertical bracing or shear walls
- It stabilizes the compression flanges of the beams against lateral buckling, until concrete hardens.
- It reduces the volume of concrete in tension zone
- It distributes shrinkage strains, thus preventing serious cracking of concrete

100. What is meant by Composite Beam Stage

The composite beam formed by employing the profiled steel sheeting is different from the one with a normal solid slab, as the profiling would influence its strength and stiffness. This is termed 'composite beam stage'. In this case, the profiled deck, which is fixed transverse to the beam, results in voids within the depth of the associated slab.

101. Write short notes on composite slab stage

The structural behaviour of the composite slab is similar to that of a reinforced concrete beam with no shear reinforcement. Steel sheeting provides adequate tensile capacity in order to act with the concrete in bending. However, the shear between the steel and concrete must be carried by friction and bond between the two materials. The mechanical keying action of the indents is important. This is especially so in open trapezoidal profiles, where the indents must also provide resistance to vertical separation.

102. What are economical considerations for industrial truss?

- Method of fabrication and erection to be followed, facility for shop fabrication available, transportation restrictions, field assembly facilities.
- Preferred practices and past experience.
- Availability of materials and sections to be used in fabrication.
- Erection technique to be followed and erection stresses.
- Method of connection preferred by the contractor and client (bolting, welding or riveting).
- Choice of as rolled or fabricated sections.
- Simple design with maximum repetition and minimum inventory of material.

103. Write about basics of plastic analysis?

In plastic analysis and design of a structure, the ultimate load of the structure as a whole is regarded as the design criterion. The term plastic has occurred due to the fact that the ultimate load is found from the strength of steel in the plastic range.

This method is rapid and provides a rational approach for the analysis of the structure. It also provides striking economy as regards the weight of steel since the sections required by this method are smaller in size than those required by the method of elastic analysis.

104. What is meant by first yield moment?

As W is increased gradually, the bending moment at every section increases and the stresses also increase. At a section close to the support where the bending moment is maximum, the stresses in the extreme fibers reach the yield stress. The moment corresponding to this state is called the **first yield moment My**, of the cross section.

105. Write about Principles of plastic analysis

(i) Mechanism condition: The ultimate or collapse load is reached when a mechanism is formed. The number of plastic hinges developed should be just sufficient to form a mechanism.

(ii) Equilibrium condition: $\Sigma Fx = 0$, $\Sigma Fy = 0$, $\Sigma Mxy = 0$

(iii) Plastic moment condition: The bending moment at any section of the structure should not be more than the fully plastic moment of the section.