MARIA COLLEGE OF ENGINEERING

ATTOOR

Department of civil engineering

QUESTION BANK

SUBJECT : DESIGN OF STEEL STRUCTURES

CODE : CE 62

CLASS : III Year / VI Semester

UNIT–I

INTRODUCTION

Two MarksQuestions andAnswers

1. Whatarethefactorsthatwillgovernthestructural design?
   - Itshould haveadequatestrength
   - Itshould haveadequatestabilityandrigidity
   - Itshouldbedurable
   - Itshouldnotinterferewiththefunctional requirement
   - Itshouldbeeconomical
2. Whatarethestructuralelementsofa building?
   - Flexural members:beamsor girders
   - Tensionmembers: ties
   - Compressionmembers:Column, stanchions, struts
   - Torsionalmembers
3. What is meant by spandrel beam?

   Beamaroundtheoutsideperimeterofa floorthatsupporttheexteriorwallsand outsideedgeof thefloor
4. What are the steps involved in structural design?
   - Selectionof thestructure
   - Layoutof thestructure
   - Determinationof forceonthestructureintheelements ofthestructure
   - Checkingtheperformanceof thestructureunderservicecondition
5. Which type of steel is generally used in construction?
   - Mildsteel
   - Mediumcarbonsteel
   - Highcarbonsteel

   These three typesof steelareknownasstructuralsteel

6. What are the various types of structural steel section?
   - Rolledsteel beamsection
   - Rolledsteel anglesection
   - Rolledsteel bars
   - Rolledsteel sheetsor strip
   - Rolledsteel channel section
   - Rolledsteel teesection
   - Rolledsteel plates
   - Mildsteel

7. What are the types of connections used for connecting structural members?
   - Rivetedconnections
   - Boldedconnections
   - Pinnedconnections
   - Weldedconnections
8. What is rivet and riveting?

   Rivet:

   A pieceof roundsteel forgedin placetoconnecttwosteel members together isknown as a rivet.Thebodyof istermedas shank

   Riveting:

   Rivetingisamethodof joiningtogether ,structuralsteel componentsbyinserting ductilemetalpins calledrivets intoholesofthecomponents tobeconnected
9. What are hot driven and cold driven?

   Hotdriven:

   Iftherivets usedinstructuralsteel workaresteel workareheatedanddriven,these rivetsareknownas hotdrivenrivets

   Cold driven:

   Iftherivets aredrivenatatmospherictemperature,theyareknownas coldrivets
10. What are the types of rivets joints?

    Whenonemember isplacedabovethe other andtheothertwoareconnectedby meansof rivets,thejointis knownas lapjoints
11. Define rivet value?

    Strengthofrivetinshearingand bearingarecalculatedandthelesservalueamong twois knownas rivetvalue
12. What are the arrangements of rivets?
    - Chainriveting
    - Diamondriveting
13. What are eccentric riveted connections?

    When thecenterof gravityof a groupofrivets doesnotlieonthelineof actionof theload,theconnections areknownasrivetedconnection
14. Define bolts?

    A bolt is a metal pin with a head at one end and the shank threads at the other in order to receive a nut

15. What are the types of welded joints?
    - Buttweld
    - Filletweld
    - Slotweldand plugweld
    - Spotweld
    - Seamweld
    - Pipeweld
16. Define butt weld?

    Buttweldis alsocalledasgrooveweld.Thefacesof twomembers areplacedwitheach otherandconnectedbyfilletmetals. Buttweldis usedtojoinstructuralmembers carryingdirectcompressionor tension.
17. Define fillet weld?

    Afilletweldis a weldofapproximatelytriangularcross sectionjoiningtwosurfaces approximatelyatrightangles toeachother inlapjoint.
18. Write down the equation for calculating the effective throat thickness of a weld?

    Effectivethroatthickness, t=0.7xsizeofweld.
19. Define factor of safety?

    Itis definedas thefactor bywhichtheyieldstressof thematerial isdividedto givethe stress inthematerial.
20. Write Unwin's formula?

    $d=6.04\sqrt{t}$

    Where,

    t= thickness of plate in mm

    d= diameter of rivet in mm.
21. Name the types of properties of structural steel?

    Two types of properties of steel structure is

    (i) Physical properties

    (ii) Mechanical properties
22. List out the physical properties of structural steel?

    (a) Unit mass of steel , $\rho = 7850\ kg/m^3$

    (b) Modulus of Elasticity, $E = 2.0 \times 10^5\ N/mm^2$

    (c) Poisson's Ratio, $\mu = 0.3$

    (d) Modulus of rigidity, $G = 0.769 \times 10^5\ N/mm^2$

    (e) Coefficient of thermal expansion, $\alpha_t = 12 \times 10^{-6}/^{\circ}C$
23. List out the Mechanical properties of structural steel?

    (a) Yield Stress, f_y

    (b) The Tensile or Ultimate stress, f_u

    (c) The maximum percentage elongation on a standard gauge length

    (d) Notch Toughness
24. Name the various types of loads to be considered in design of steel structures?

    (i) Dead load (DL)

    (ii) Imposed load (IL)

    (iii) Wind load (WL)

    (iv) Earthquake load (EL)

    (v) Erection load (ER)

    (vi) Accidental load (AL)

    (vii) Secondary effect.

25. List out two limit states?
    (i) Limit state of strength
    (ii) Limit state of serviceability
26. What is limit state?
    Limit state are the state beyond which the structures no longer satisfied the specified performance requirements.
27. What are the limit states of strength?
    (i) Loss of equilibrium of whole or part of the structures
    (ii) Loss of stability of structures as a whole or part of it
    (iii) Failure by excessive deformation
    (iv) Fracture due to fatigue
    (v) Brittle fracture
28. What are the serviceability limit states?
    (i) Deformations and deflection adversely affecting the appearance or effective use of structures
    (ii) Repairable damage or crack due to fatigue
    (iii) Correction
    (iv) Fire
29. What are bolts and its types?
    A bolt is a metal pin with a head formed at one end and shank threaded at the other in order to receive a nut. The three types of bolts are
    (i) Unfinished (black) bolts
    (ii) Finished (Turned) bolts
    (iii) High strength friction grip (HSFG) bolts
30. What is an Unfinished (black) bolts?
    Bolts are made from mild steel rods with square or hexagonal head. The shank is left unfinished i.e. rough as rolled
31. What is a Finished (Turned) bolts?
    Bolts are made from mild steel rods, but they are formed from hexagonal rods, which are finished by turning to a circular shape.
32. What is a High strength friction grip (HSFG) bolts?
    The HSFG bolts are made from high strength steel rods. The surface of the shank is kept unfinished as in the case of black bolts.

UNIT-II

TENSION MEMBERS

1. Definetensionmembers?
    Tensionmemberis definedasa structuralmembersubjectedtoatensileforcein thedirectionparallelto its longitudinalaxis. Atensionmemberis alsocalledas tiememberorsimply atie. Thetermtieiscommonly usedfortensionmember intherooftruss.

2. What are the types of tension members?
   - Wires andcables
   - Rods andbars
   - Singlestructuralshapesandplates
   - Builtupmembers

3. Why lug angles are not very common?
   - Theyprovideeccentric connectionsbecauseofrivets placedalong lug angles
   - Stressdistributionin therivetoflug isnotuniform
   - Rivets on thelug anglearenotassufficientas otherrivets.

4. Write notes on lug angles?

   Whenatensionmemberis connectedtoagussetplateandits ends alarge numberofrivetsarerequired,especially when the tensionmemberis large, necessitating intheprovisionofabig sizegussetplate. Thesizeof thegusset platecanbedecreasedby theuseofalug angle. Alug angleis ashortlengthof an anglesectionwhichisattachedtoa maintensionmemberat theconnecting end toprovideextra gaugelines foraccommodatingtherequirednumberofrivets.

5. How is the net sectional area calculated in case of i) chain riveting ii) zigzag riveting?
   - Chainriveting
     $A_{net}=t(b-nd)$
   - Zigzagriveting
     $A_{net}=t[(b-nd) +ms^2/4g]$

   Where,

   t=thicknessofplate
   d=diameter ofthehole
   n=noofrivets inthesection considered
   m =no of zigzagorinclinedlines.

6. What is net selection area?

   Thenetselectionareaofa tensionmemberisthegross sectionalareaof the member,lessthemaximum deductionforholes.

7. What is net effective area?

   Thenetcross sectionalarea ona sectionis reducedtoaccount forthisnon-uniform stressdistributionresultingfromeccentricity. Thereducednetsectional area ofsucha sectionisknownas neteffectivearea.

8. What is lug angle?

   A lug angleis a shortlengthofananglesectionwhichis attached tothemain tensionmemberattheconnectingendtoprovideextragaugelines for accommodatingtherequirednumberofrivets.

9. What is the design of a tension member?

(a) Design strength due to yielding of gross section, T_{dg}
(b) Rupture strength of critical section, T_{dn}
(c) The block shear, T_{dh}

10. How is net effective area of a single angle used as tension member calculated?

Incaseofsingleangleconnectedthroughonelegthe

Netsectionalarea =A_1+A_2k

Where,

A_1=effectivecross sectionalarea oftheconnectedleg

A_2=gross cross sectionalarea ofthe unconnectedleg

$K=3A_1/ (3A_1+A_2)$

11. Write down the formula for permissible stress in axial tension?

As per IS: 800-1984: the permissible stress in axial tension,

$$\sigma at = 0.6fy\ N/mm^2$$

Where,

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

12. Write down the specification for the design of lug angle?

Lug angleconnectedachannelshapedmembershall,asfaras possible, bedisposedsymmetrically withrespecttothesection.

Innocaseshallfewerthan twobolts orrivets beusedforattaching thelug angletothegussetorothersupportingmember.

13. How is net effective area of a double angle used as tension member calculated?

Incaseofdoubleangleconnected throughoneleg,

Netsectionalarea=A_1+A_2k

Where, A_1=effectivecross sectionalarea oftheconnectedleg

A_2=gross cross sectionalarea ofthe unconnectedleg

$K=5A_1/ (5A_1+A_2)$

14. What are hangers?

A tensionmemberis theonewhichis intendedtoresistaxialtension. Tension memberarealsocalled ties orhangers.

15. What is the advantage of rods and bars?

Themajordisadvantageofthesesectionsistheinadequatestiffness resulting in noticeablesag undertheirownweightespeciallyduring erection.

16. Notes on single structural shapes and plates?

Thecommonsinglestructuralshapes areanglesection,teesection,channel section. Anglesections areconsideredmorerigidthanropes,rods,bars. So=ingle anglearemainly usedforbracing,forlighttruss tensionmember.

17. Explain the member?

Tensionmemberarealsocalledastiemember.A tensionmemberpertie

memberistheonewhichis intendedtoresistaxial tension.

18. Write notes on built-up section?

Whenamemberis requiredtotakeheavy tensileload, builtupsections, consistingoftwoormoreplatesorshores areused. Sucha builtupsectionis used toprovide

- Greaterarea whichcannotbeprovidedby asinglerolledshape,
- Greaterrigidity byway ofgreatermomentofinertia,
- Suitabledimensiontoproperconnection

19. What is bearing stress?

When theloadisexertedortransferredbytheapplicationofloadthroughone surfacefortheothersurfaceincontacttothestress is knownasbearing stress. Thebearing stress is calculatedonnetprojectedarea ofcontact.

$$\sigma bf = P/A.$$

20. Write notes on tension member splice.

If a single piece of required length is not available tension members are spliced to transfer required tension from one piece to another. The strength of the splice plates and the bolts/weld connecting them should have strength at least equal to the design load. When tension member of different thickness are to be connected, filler plates may be used to bring the members in level. The design shear capacity of bolts carrying shear through a packing plate in excess of 6mm shall be decreased by a factor.

$$\beta_{pk} = 1 - 0.0125\ t_{pk}$$

21. Give the types of steel sections used as tension members.

(a) Wires and Cables, (b) Rods and Bars, (c) Single Structural shape and plates, (d) Built up members.

UNIT-III

COMPRESSION MEMBERS

1. Define the strength of compression members.

The strength of a compression member is defined as its safe load carrying capacity. The strength of a centrally loaded straight steel column depends on the effective cross sectional area, radius of gyration, the effective length of magnitude and distribution of residual stresses, annealing out of straightness and cold straightening.

2. Where tee-section is used?

The tee-sections are suitable for the compression members for small trusses. The tee-sections are more suitable for welding.

3. What is meant by built-up compression members?

A built-up compression member may consist of two or more rolled structural steel sections connected together effectively and act as one compression member.

The built-up compression members are given effective column cross-sections.

4. Write down the reasons for using built-up sections?
    1. The built-up sections provide large cross-section area, which cannot be furnished by single rolled steel sections.
    2. The built-up sections provide special shape and depth. The special shape and depth facilitate connections between the different members.
    3. The built-up sections provide sufficient large radius of gyration of more desirable ratio of gyration in two different directions. In the single rolled steel section the ratio of radii of gyration in two directions cannot be altered.
5. What is thickness of elements in compression members?

    In local buckling waves, or wrinkles are formed in the elements of compression members. These thicknesses have been recommended to avoid the failure of elements owing to local buckling.

6. Write two limitation of Euler's formula?
    - The basic Euler's formula is only useful if the end supported conditions are carefully considered.
    - The results obtained by application of the formula to specific examples compare very well with test results for centrally loaded, long, slender columns with rounded ends.
7. What is meant by slenderness ratio?

    Slenderness ratio of a column is defined as the ratio of effective length to corresponding radius of gyration of the sections. Thus

    Slenderness ratio = l_e/r = KL/r

8. Define radius of gyration.

    Radius of gyration means the radius of gyration of compression members about the axis of buckling. If the length of the column to be considered is the same for buckling about any axis naturally the governing slenderness ratio is KL/r_{min}.
9. What is meant by effective length of column?

    The effective length L' (or L_e or KL) of a column is defined as the distance between successive inflection points or points of zero moment. Based on the effective length concept, the eeuler buckling load and stress formulas becomes, respectively

$$P_{cr} = \frac{\pi^2 EI}{(KL)^2}$$

    Where, KL = L_e = L' = effective length

10. Write the Effective length of compression members.

Boundary conditions	Theory	Code value (Cl.7.2.2)
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

11. Write short notes on Compression Members in Trusses.

In the case of bolted, riveted or welded trusses and braced frames, the effective length, KL, of the compression members shall be taken as 0.7 to 1.0 times the distance between centers of connections, depending on the degree of end restraint provided. In the case of members of trusses, buckling in the plane perpendicular to the plane of the truss, the effective length, KL shall be taken as the distance between the centers of intersection.

12. List out the failure of compression members.
    - Direct compression
    - Excessive bending
    - Bending combined with twisting.
13. List out the lateral system implemented in column.
    - Lacing or latticing column
    - Battening or batten plate column
14. Explain eccentrically loaded columns.

When a load is applied at an eccentric distance from the centroid of the column section i.e. called eccentrically loaded column, it is subjected to bending stress besides the axial compression.

15. What is lacing columns?

The lacing is also termed as latticing and it is most commonly used. The rolled steel flats, angles and channels are used for lacing. The rolled steel sections or tubes of equivalent length may also be used instead of flats.

16. What are the types of lacing?
    1. Single laced system
    2. Double laced system
17. What is batten plates?

The batten plates are also called as the plates and these are also used in lateral system. The battened compression members are subjected, in the plane of batten, to eccentric loading, applied moments or lateral forces.