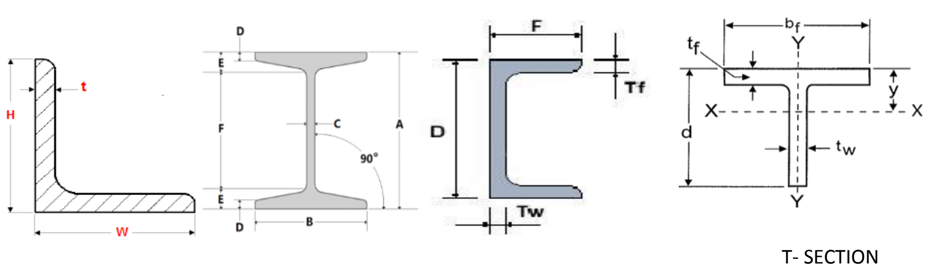
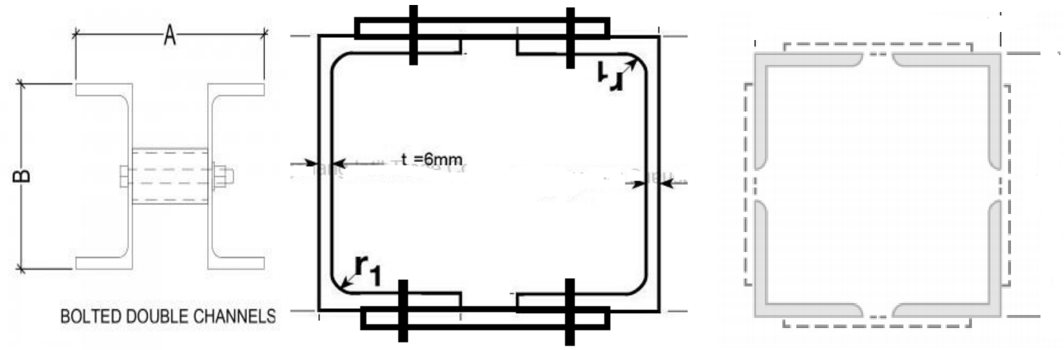
SUMMER– 18 EXAMINATION

Subject Name: DESIGN OF STEEL STRUCTURE **Model Answer** Subject Code: 17505

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answers	Marking Scheme
Q.1	A) (a) Ans	***Attempt any THREE of the following:*** State the full form of **ISMB,ISHB,ISJC,ISMT** **ISMB-Indian Standard Medium Beam** **ISHB- Indian Standard Heavy Beam** **ISJC- Indian Standard Junior Channel** **ISMT- Indian Standard Slit Medium Weight Tee Bars**	**01 M for each**
Q.1	A)b) Ans	**State** any **four** types of **load** to which structures are subjected along with respective relevant **codes.** 1.**DEAD LOAD** ----IS 875-PART-1 -1987 2. **LIVE LOAD** -- IS 875-PART-2 -1987 3. **WIND LOAD** --- IS 875-PART-3 -1987 4. **SNOW LOAD** --- IS 875-PART-4 -1987. 5.**EARTHQUAKE LOAD** ---IS 1893-2002	**01 M for each**
Q.1	A)(c) Ans	Draw any four sketches of section used as tension member.  ANGLE SECTION I-SECTION CHANNEL SECTION T- SECTION	**1 M** each (any four)

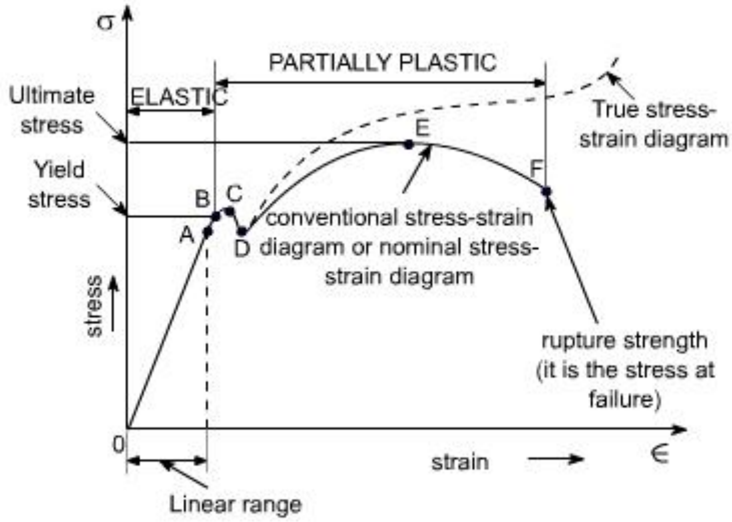


CHANNEL SECTION FACE TO FACE

FOUR ANGLE SECTION

Q.1 A)(d) Ans

Draw graph of stress-strain curve for mild steel.



POINTS OF THE GRAPH:

(A) The limit of proportionality or the proportionality limit.

(B) Elastic Limit .

(C) and (D) - upper and lower yield points

Q.1 B) (a) Ans

Attempt **any one**

Design the lap joint for plates 100 x10 mm thick connected, to transmit 100kN factored load using single row of 18 mm dia. Bolts of 4.6 grade and plates of 415 kN.

Given data :t=10 mm

P_u=100 kn

d=18mm

d_0=20mm

f_{ub}=400 N/mm^2

f_u=415 N/mm^2

V_{nsb} = nominal shear capacity of bolt

$$V_{nsb} = \frac{f_{ub}}{\sqrt{3}}(n_n A_{nb} + n_s A_{sb})$$

A_n-net area of the bolt at thread = 0.78 π $\frac{D^2}{4}$

A_{nb}-net area of the bolt at thread = 0.78 π $\frac{D^2}{4}$ =0.78 π x(18^2/4)=198.48 mm^2

$V_{nsb} = \frac{f_{ub}}{\sqrt{3}}(n_n A_{nb} + n_s A_{sb})$=(400x1x198.48)/1.732

=45.36 kN **02 M**

(i) Shear capacity of bearing bolts (V_{dsb})

$$V_{dsb} = \frac{V_{nsb}}{\gamma_{mb}}$$

Where, γ_{mb}= partial safety factor of bolt

<u>Shear capacity of bearing bolts (Vdsb) **=45.36 /1.25 =36.669 kN**</u>

ii) Nos. of bolt = factored load / bolt value =100/36.69 = 2.72 nos. =**3 nos.**

iii) to calculate pitch

$$Tdn = \frac{0.9\, fu\, (P - d_0)\, t}{\gamma m_b}$$

33.36x1000=0.9x415(P-20)X10/1.25

P=22.7

P_{min} =2.5xd =2.5x 18=45mm

iv) to calculate nominal bearing strength of bolt. **02M**

$$Vnpb = 2.5\ Kb * d * t * fu$$

e = 1.5 x d_0**=1.5 x20=30mm**

k_{b1}**=e/3 d_0 =0.5**

k_{b2} =(P/**3 d_0)-0.25 =0.5**

k_{b3} **= f_{ub}/ f_u =400/ 415 = 0.96**

k_{b4} =1

(whichever is small)

<u>**k_b =0.5**</u>

<u>**iv)nominal bearing strength of bolt =2.5 x0.5x18x20x415 =93.375 kN**</u>

design bearing strength of bolt = V_{npb} / γ_{mb}=93.375/1.25 =74.700 **kN** > 36.669 kN

02M

Q.1 B)(b) Write down the step-by-step design procedure of angle purlin as per the **IS 800-2007**

Ans

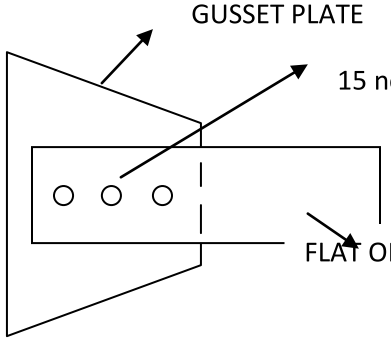
1.Angle section are unsymmetrical about both the axes . angle section can be used as a purlin .

2. angle section can be used as a purlin provided the slope of the roof truss s is less than 30^0 **02 M**

Following procedure is use for design of angle purlin.

1. The gravity loads and wind load are determined. Both the load are assume to be normal to roof truss. **02 M**
2. The maximum bending moment is computed by wl^2/10 or Wl/10
   Where w –unfactored uniformly distributed load, W unfactored concentrated load at centroid, L span of purlin. **02 M**
3. The modulus of section required is calculated by Z=M/(1.33 X 0.66Xfy),where fy – yield stress.
4. A trial section of angle purlin is arrived at by assuming the depth of the angle section at 1/45 of the span and width of the angle section as 1/60 of the span. The depth and width must not be less than specified values to ensure that the deflection are not excessive.

		5. A suitable angle section is selected from IS handbook for the calculated leg length of angle section .the modulus of section provided should be more than modulus of section calculated in step no.3.	
Q.2		Attempt **any two**	
	(a)	A flat 250 x 10 mm is connected to gusset plate using 20mm dia.bolts of 4.6 grade design lap joint and draw neat sketch of joint designed.	
	Ans	Nominal daim. Of bolt = 20mm A_{nb}-net area of the bolt at thread = 0.78 π $\frac{D^2}{4}$ =0.78 π x(20^2/4)=245.04 mm^2 For bolts of grade 4.6 **f_{ub}=400 N/mm^2** **f_u=415 N/mm^2** i)find design shearing strength of bolt V_{nsb} = nominal shear capacity of bolt	
		$V_{nsb} = \frac{f_{ub}}{\sqrt{3}}(n_n A_{nb} + n_s A_{sb})$=(400x1x245.04)/1.732 **=56.59 kN**	02 M
		Shear capacity of bearing bolts (V_{dsb}) $V_{dsb} = \frac{V_{nsb}}{y_{mb}}$ Where, y_{mb}= partial safety factor of bolt Shear capacity of bearing bolts (Vdsb) **=56.59 /1.25 =45.272 kN**	02 M
		ii) to calculate nominal bearing strength of bolt. Vnpb = 2.5 Kb * d * t *fu e = 2 x **d_0=2 x20=40mm , P=2.5 D =2.5 X 20 =50 mm** **k_{b1}=e/3 d_0 =0.606** **k_{b2}** =(P/**3 d_0)-0.25 =0.507** **k_{b3} = f_{ub}/ f_u =400/ 415 = 0.96** **k_{b4}** =1 **(whichever is small)** **k_b =0.507**	
		ii)nominal bearing strength of bolt =2.5 x0.507x20x10x415 =103.93 kN **design bearing strength of bolt = V_{npb} / y_{mb}**=103.97/1.25 =83.148 **kN** (therefore bolt value =45.271 **kN)**	02M
		iii)Full strength of member =0.9 x(f_u/ y_m)x area of plan **= 0.9 x(410/1.25)x(250-1x22)x10** **=673.05 kN**	01 M
		iv) Nos of bolts required = full strength of bolt /bolt value **= 673.056 /45.271 = 15 nos.**	01 M



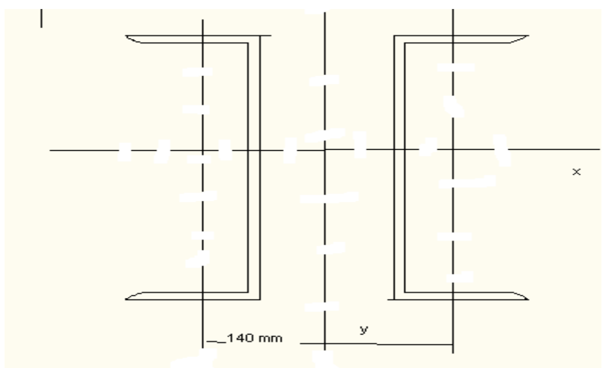
Q.2 (b)

A built-up column consist 2 ISMC -225 placed back to back at 140 mm.The length of column is 8m effectively held in position and restrained against rotation at both ends find design strength of column. For **1 ISMC 225**

A= 3301mm I_{xx} =26.946 x 10^6 mm^4,I_{yy}=1.872 x 10^6 mm^4, C_{yy} =23.1mm

KL/r	40	50	60	70	80	90	100
F_{cd}	198	183	168	152	136	121	107

Ans



Area of composite section, A_g = 2 x 3301 = 6602 mm^2

Based on $r_{xx} = r_x = \sqrt{(Ixx / A)} = \sqrt{(26.946 \times 10^6 / 3301)}$

= 90.34 mm -- 02M

$I_{yy} = 2[I_y + Ah^2]$

$= 2[1.872 \times 10^6 + 3301 \times (140/2)^2]$

= 17994900 mm^4

$r_{yy} = \sqrt{(I_{yy} / A)} = \sqrt{(17994900 / 6602)}$

= 52.20 mm.

Hence r_{min} = 52.20 mm 02M

For given end condition, kL = 0.65L --------------------

$SR = kL / r_{min}$

= 0.65 x 8000 / 52.20

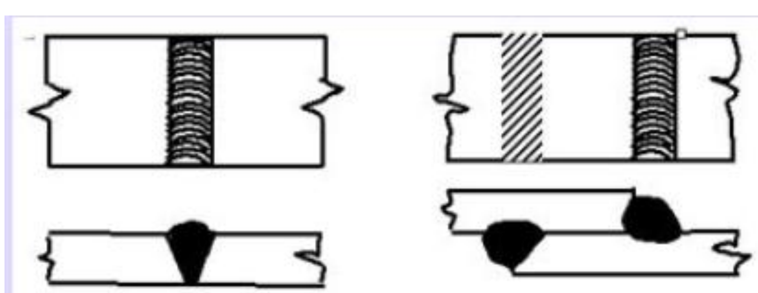
= 99.61

KL/r	90	100
F_{cd}	121	107

For built up section, buckling class is C for which-

$f_{cd} = f_{cd1} – [(f_{cd1} – f_{cd2}) / (SR_2 – SR_1)] \times (SR – SR_1)$ 02M

$= 121 – [(121 – 107) / (100 – 90)] \times (99.61 – 90)$

		= 107.546 mPa. --- Design compressive strength $P_d = f_{cd} \times A_g$ = 107.546 x 6602 = 710018 N = 770.018 kN. --	02M
Q.2	(c) Ans	An ISMB 400 @ 604.3 N/m is used as simply supported beam of span 4.0 M. The compression flange of the beam is laterally supported throughout the span. Determine design flexural strength working udl on the beam per meter span. Take Zp = 1176.18 x $10^3 mm^3$, Ymo = 1.1, βb = 1.0, fy = 250 mPa. Given L = 4 m = 4000 mm Zxx = Zp/s = 1176.18 x 103 / 1.14 = 1031.74 x 10^3 mm^3 Ixx = Zxx x ymax = 1031.74 x 10^3 x 400/2 = 206.35 x 10^6 mm^4 Assuming udl = 'w' kN/m. **i.To calculate design flexural strength, Md** **Md = (βb x Zp x fy) / Ymo = (1 x 1176.18 x 103 x 250) / 1.10** **= 267.27 x 106 N-mm = 267.27 kN-m.** -- ii. M_u = wu x $L^2/8 = w_u \times 4^2/8 = 2\ w_u$ **kN/m** iii. Equating Md and Mu 267.27 = 2wu **w_u = 131.135 kN/m.** **w = wu/ Yf = 131.135/1.5 = 87.42 kN/m.** ---	04 M 04 M
Q.3	 (a) Ans	Attempt **any four** Define bolt value, pitch, gauge and edge distance in bolted joint. i)bolt value:-is defined as the overall strength of fastener for design purpose and it is taken as minimum of Shearing strength and Bearing strength of bolt. ii)pitch, **i) Pitch:** it is the centre to centre distance of the bolts in a row, measured along the direction of load. iii)gauge:-It is a distance between the two consecutive bolts of adjacent rows and it is measured at right angle to the direction of load. iv)edge distance **iii) Edge distance:** it is the distance from centre of bolt hole to the nearest edge of plate measured perpendicular to the direction of load.	**1M** **1M** **1M** **1M**
	b) Ans	State two types of welded joints and draw sketch of any one. **Types Of Welded Joints** 1.Butt weld 2.Fillet weld  (a) Butt welds s(b) Fillet weld **Draw sketch of any one.**	**02 M** **02 M (any one)**

Q.3 (c) Write the specification of IS code for design of angle purlin

Ans

1.Angle section are unsymmetrical about both the axes . angle section can be used as a purlin .

2. angle section can be used as a purlin provided the slope of the roof truss s is less than 30^0

04 M

Following procedure is use for design of angle purlin.

1. The gravity loads and wind load are determined. Both the load are assume to be normal to roof truss.
2. The maximum bending moment is computed by $wl^2/10$ or Wl/10
   Where w –unfactored uniformly distributed load, W unfactored concentrated load at centroid, L span of purlin.
3. The modulus of section required is calculated by Z=M/(1.33 X 0.66Xfy),where fy –yield stress.
4. A trial section of angle purlin is arrived at by assuming the depth of the angle section at 1/45 of the span and width of the angle section as 1/60 of the span. The depth and with must not be less than specified values to ensure that the deflection are not excessive.
5. A suitable angle section is selected from IS handbook for the calculated leg length of angle section .the modulus of section provided should be more than modulus of section calculated in step no.3.

Q.3 (d) Enlist any eight types of steel roof trusses with their spans .

Ans

Sr.no	types of steel roof trusses	spans .
1.	King Post Truss	6 meters
2.	Queen Post Truss	6-9meters
3.	Howe- triangle 4-pannel –	6-15 meters
4.	Howe- triangle 6-pannel –	12-24 m
5.	Fink or French truss	12-18m
6.	Compound French truss	20-30 m
7.	Pratt Truss –	16-30 meters
8	Fan Truss –	10-15 meters
9.	North Light Roof Truss	8-10 meters.

Any eight 01 M for each

Q.3 (e) Write the design steps for wind load in steel roof truss.

Ans

design steps to calculate wind load on roof truss as per IS-875-1987:

1. Design wind speed (Vz)=k1 k2 k3 Vb

i. Risk Coefficient-(**k1)**

ii. Terrain ,Height And Structure Size Factor, **k2**

iii. Topography Factor. **k3**

iv. basic wind speed -Vb

2. wind pressure (Pz)=0.6 (Vz)2----(N/m^2)

3. wind load on roof

F = (Cpe - Cpi)Apz

Cpe - Coefficient of external wind pressure

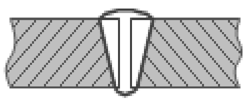
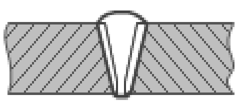
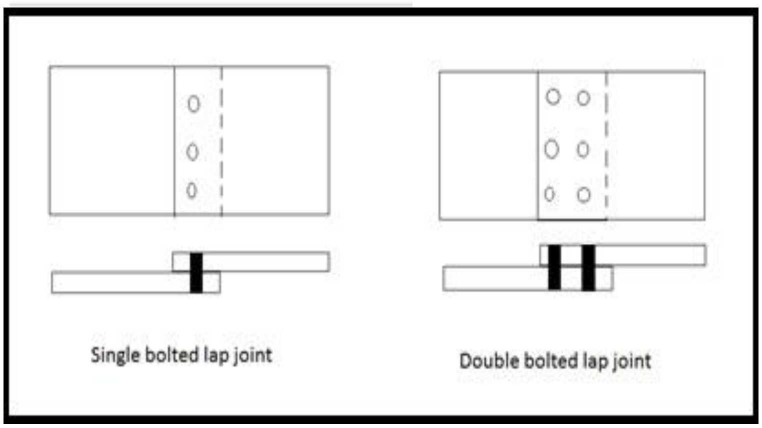
Cpi - Coefficient of internal wind pressure

A - surface area of structural element in (m2)

pz - design wind pressure **(N/m^2)**

4 M

Q.4 Attempt **any three**

	(a) Ans	**Define effective length and slenderness ratio for column** **Effective length: this is the length of column in a buckled condition between two successive points of contraflexure.** **slenderness ratio: It is defined as the ratio of effective length to least radius of gyration of the section.**	**02M** **02M**
Q.4	(b) Ans	Draw a neat sketch of a)V-butt welded joint b) lap bolted joint  Butt weld  Butt weld, single-V 	**02M** **02M**
Q.4	(c) Ans	State general requirements of lacing as per IS code	

General requirements for lacing as per IS-800.

a) Members comprising two main components laced and tied, should where practicable, have a radius of gyration about the axis perpendicular to the plane of lacing not less than the radius of gyration about the axis parallel to the plane of lacing.

(b)As far as practicable, the lacing system shall be uniform throughout the length of the column.

c) Except for tie plates double laced systems and single laced systems on opposite sides of the main components shall not be combined with cross members (ties) perpendicular to the longitudinal axis of the strut, unless all forces resulting from deformation of the strut members are calculated and provided for in the design of lacing and its fastenings.

d) Single laced systems, on opposite faces of the components being laced together shall preferably be in the same direction so that one is the shadow of the other, instead of being mutually opposed in direction.

04 M

e) The effective slenderness ratio, (kl/r)e., of laced columns shall be taken as 1.05 times the (Kl/ r)o, the actual maximum slenderness ratio, in order to account for shear deformation effects.

f) Width of Lacing Bars In bolted/riveted construction, the minimum width of lacing bars shall be three times the nominal diameter of the end bolt rivet.

g) Thickness of Lacing Bars The thickness of flat lacing bars shall not be less than one-fortieth of its effective length for single lacings and one-sixtieth of the effective length for double lacings.

h) Rolled sections or tubes of equivalent strength may be permitted instead of flats, for lacings.

i) Angle of Inclination: Lacing bars, whether in double. Or single systems, shall be inclined at an angle not less than 40° or more than 70^0 to the axis of the built-up member.

j)The maximum spacing of lacing bars, whether connected by bolting, riveting or welding, shall also be such that the maximum slenderness ratio of the components of the main member, between consecutive lacing connections is not greater than 50 or 0.7 times the most unfavorable slenderness ratio of the member as a whole, whichever is less, where al is the unsupported length of the individual member

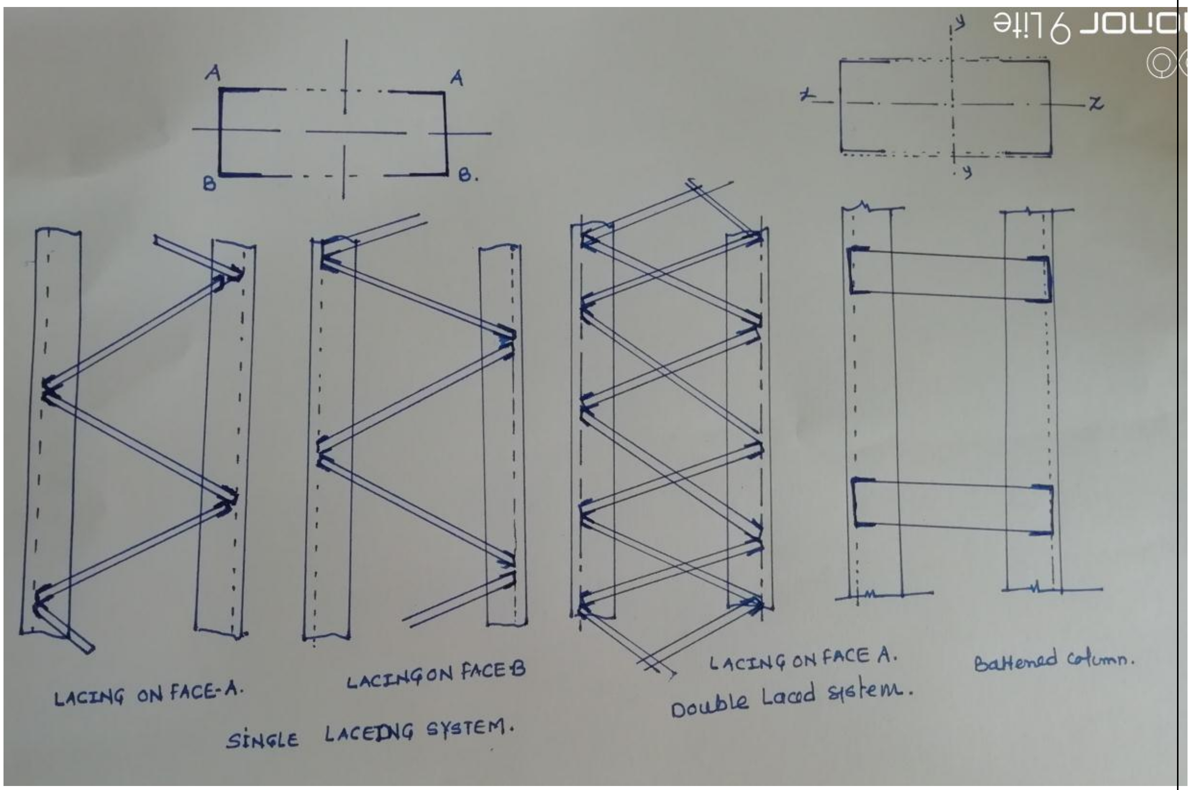
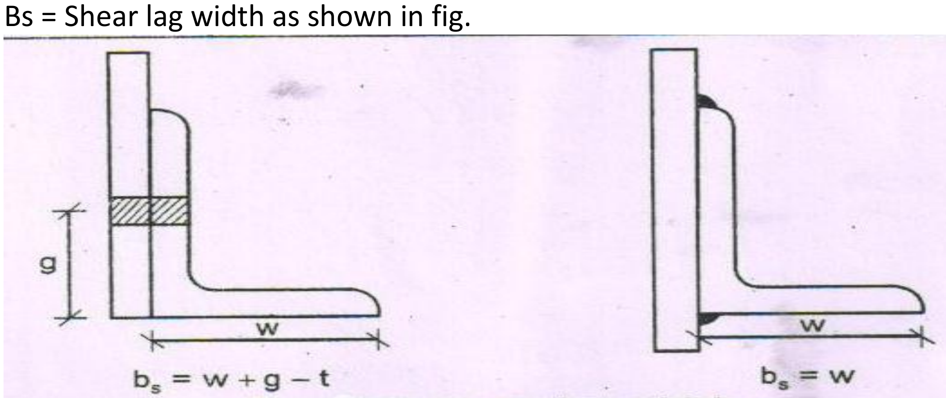
Between lacing points, and r, is the minimum radius of gyration of the individual member being laced together.

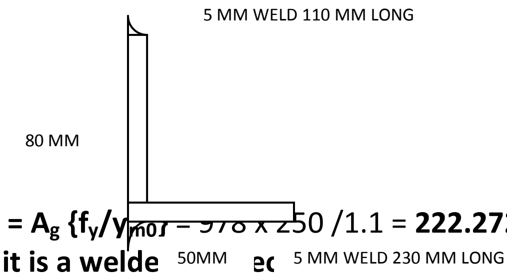
k) Where lacing bars are not lapped to form the connection to the components of the members, they shall be so connected that there is no appreciable interruption in the triangulation of the system.

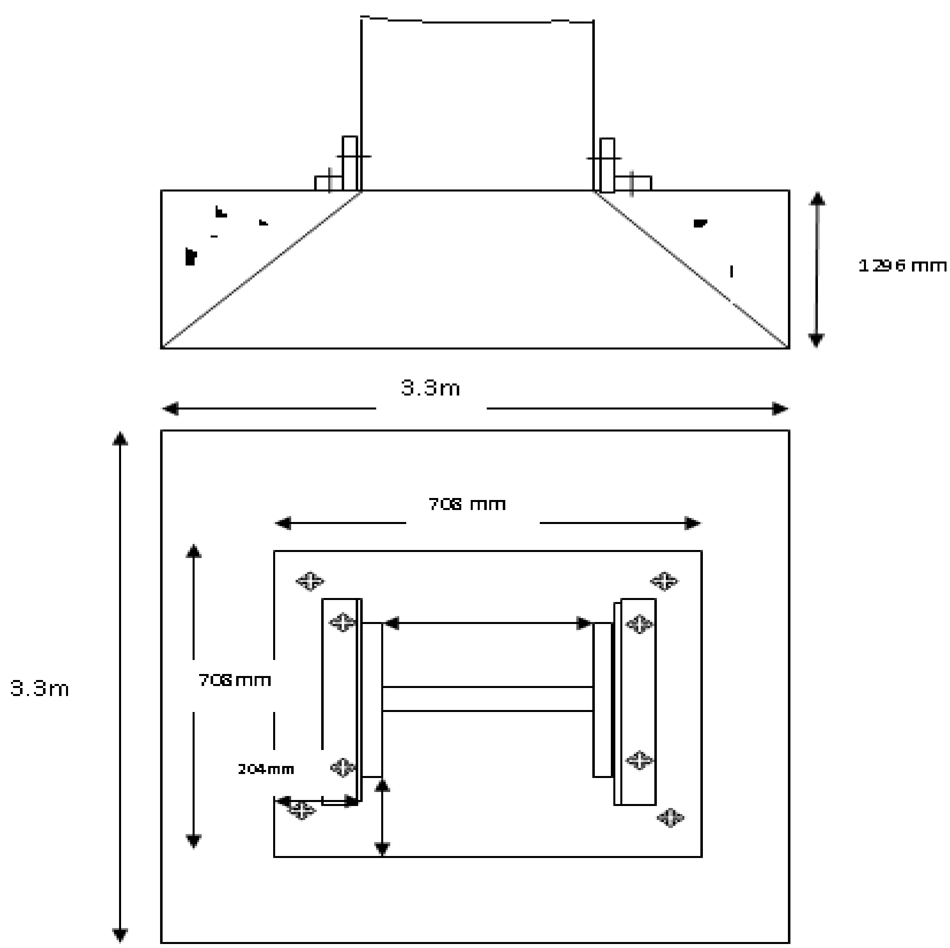
l) The lacing shall be proportioned to resist a total transverse shear, Vt, at any point in the member, equal to at least 2.5 percent of the axial force in the member and shall be divided equally among all transverse lacing systems in parallel planes.

m) For members carrying calculated bending stress due to eccentricity of loading, applied end moments and/or lateral loading, the lacing shall be proportioned to resist the actual shear due to bending.

n) The slenderness ratio, Kl/r, of the lacing bars shall not exceed 145. In bolted/riveted construction, the effective length of lacing bars for the determination of the design strength shall be taken as the length between the inner end fastener of the bars for single lacing, and as 0.7 of this length for double lacings effectively connected at intersections. In welded construction, the effective lengths shall be taken as 0.7 times the distance between the inner ends of welds connecting the single lacing bars to the members.

	d)	Draw a net sketches of lacing and battening system showing with weld connection.  	04 M
Q.4 (B)	(a) Ans	Explain the concept of shear lag phenomenon with suitable example . also comment whether this phenomenon is same for both welded and bolted connection or not. Shear lag: While transferring the tensile force from gusset plate to tension member through one leg by bolt or welds, the connected leg of section (such as angle, channel) 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 leg behind the other is called as shear lag. The tearing strength of an angle section connected through one leg is affected by shear lag also. Thus the design strength τdn governed by tearing of net section is given by, $\tau dn = [0.9 (Anc \times fu) / Ym1)] + [\beta \times (Ago \times fy / Ymo)]$ Where $\beta = 1.4 – 0.076 (w/t) (fy/fu) (bs/Lc)$ Bs = Shear lag width as shown in fig.  Fig: Shear lag width	03 M

		Comments : To maintain a uniform approach to both welded and bolted members, the same provisions for shear lag in bolted members were applied to welded members.	01 M
Q.4	(B) (b) Ans	Determine the design strength of single angle in tension member using **ISA 80x50x8** mm.The longer leg is connected to gusset plate 10 mm thick by 5mm weld as shown in fig. for ISA Ag= 978 mm^2 β= 1.18  1. **T_{dg} = A_g {$f_y/γ_{m0}$}** = 978 x 250 /1.1 = **222.272 kN**--- 2. **As it is a welde[illegible]** **T_{dn} = 0.9 xA_{nc} {$f_y/γ_{m1}$} + βxA_{go} {$f_y/γ_{m0}$}** **β = 1.4 -0.076{w/t}{fy/fu}{bs/lc}** **β** =1.4 – 0.076{50/8}{250/410}{50/230}=1.192 > 0.7 <0.9 x (410x 1.1)/(250 x1.25) =1.2988 **therefore ok** **T_{dn}** = 0.9 x(80-4)x8x {410/1.25} + 1.274x(50-4)x8({250/1.10} = **286.03 kN---------** **T_{db}** for gusset plate 10 mm thick **T_{db} = A_{vg}{f_y/(1.732x$γ_{m1}$)} + 0.9xA_{tn} {$f_u/γ_{m1}$}** **T_{db}** = (50x10+230x10)x{250/(1.732x1.1)} + 0.9x80x10x {410/1.25} **T_{db}** =367415.49+236160=**603.575 kN---** **Or** **T_{db} = 0.9xA_{vn} {f_u/(1.732x$γ_{m1}$) } +A_{tg}{f_y/ $γ_{m1}$}** **T_{db} = 0.9x(50 x10+230 x10) {410/(1.732x1.25) } +(80 x10){250/ 1.1}** **T_{db} = 659.046 kN--** **T_{db} for member ISA 80x50x8 is in relation with the thickness of gusset plate of 10 mm thickness** **Therefore** **T_{db} = 659.046 x 8 /10 = 527.23 kN** **T_{db} =603.575x 8 /10 = 482.86 KN---** **Therefore the strength of member is the least of** **1. T_{dg} =222.272 kN** **2.T_{dn} = 286.03 kN** **3. T_{db} = 482.86 kN** **<u>Therefore the strength of member is 222.272 kN</u>**	01 M 01 M 01 M 01 M 01 M 01 M
Q.5 Ans	 (a)	Attempt **any two** Design a square slab base and concrete block for column section SC250 with two cover plates 300x25 mm carrying 3000 Kn axial Load . take M15 , tf = 17 mm , bf= 250 mm overall hight h = 300mm amd SBC= 300 kpa . Given: SC 250, P = 3000 kN, SBC = 300 kPa, M15 – fck = 15 N/mm^2, f_y = 250 mPa, b_f = 250 mm, t_f =17 mm P_u = 3000 x 1.5 = 4500 kN. **Bearing area of base plate (A)** = $P_u/(0.6f_{ck})$ = (4500 x 10^3) / (0.6 x 15) = **500000** mm^2 ------------------- For a square base plate Size of plate=√**500000 = 707.106 mm** Size of plate for equal projections a and b	 2M

		L_p = 708 mm say L_p = 708 mm, B_p = 708 mm	
		Larger projection a = (L_p – D) / 2 = (708 – 350) / 2 = 179 mm	2M
		Smaller projection b = (B_p – B) / 2 = (708 – 300) / 2 = 204 mm	
		Ultimate pressure from below on the base plate-	
		$W = P_u / (L_p \times B_p) = 4500 \times 10^3 / (708 \times 708) = 8.97\ N/mm^2$	
		Thickness of base plate	
		$t_s = \sqrt{[2.5 \times w \times (a^2 - 0.3b^2) \times Y_{mo} / f_y]} > t_f$	2M
		$= \sqrt{[2.5 \times 8.97 \times (179^2 - 0.3 \times 204^2) \times 1.1 / 250]}$ = 43.97 mm say 45 mm >17 mm (t_f) Size of concrete block-	
		$A_f = (P_u \times Y_{mo}) / SBC \times Y_f) = (4500 \times 1.1) / (300 \times 1.5) = 11\ m^2$	
		For equal projection-	
		L_f = 3.31m say L_f = 3.3 m , B_f = 3.3 m	1M
		Provide M15 concrete pedestal of size 3.3m x3.3 m Actual projection-	
		= (L_f – L_p) / 2 = (3300 – 708) / 2 = 1296 mm and	
		= (B_f – B_p) / 2 = (3300 – 708) / 2 = 1296 mm	
		Considering 45^0 angle of dispersion, **Df = 1296 mm.**	
			1M

Q.5 (b) Calculate DL and LL per panel for steel roof truss having span =20 m panel points =10 spacing =4m rise =3m wt. of GI Sheets = 100 N/m^2 bracing =75 N/m^2 wt. of purlin =150 N/m^2

Ans

Given: i) Unit wt. of roof covering(GI Sheets) = 100N/m^2
ii)Self-wt. of purlin = 150 N/m^2
iii)Wt. of bracing = 75 N/m^2
ii) Rise=3m
iii) Total no. of panels=10
iv) Span =20 m

a. Calculation of Dead load: — 1M

i. Self-weight of truss = [(L/3) + 5] x 10
= [(20/3) + 5] x 10 = 116.67 N/m^2 ---
ii.Unit weight of roof covering = 100 N/m^2
iii.Self-weight of purlin = 150 N/m^2 — 1M
iv.Weight of bracing = 75 N/m^2
Hence Total Dead load per m^2 = 116.6 + 100 + 150 + 75 = 441.66 N/m^2 -------------------- — 1M
Dead load per intermediate panel point = Dead load per m^2 x plan area of roof per panel pt. — 1M

Dead load per intermediate panel point = 441.6 x 4 x (20/10) = 3532.8 N. ---------------------

Dead load per end panel point = 3532.8/2 = 1766.4 N. --- — 1M — 1M

b. Calculation of Live load:

Angle of truss (θ) = $\tan^{-1}$[3/(10)] = 16.69^0 — 1M
Live load on purlin = 750 – [(16.69 – 10) x 20] — 1M
= 616 N/m^2 > 400 N/m^2 Hence OK --
Live load on truss = (2/3) x 616 = 410.67 N/m^2 ---
Live load per intermediate panel point = Live load per m^2 x plan area of roof per panel point

Live load per intermediate panel point = 410.67 x 4 x (20/10) = 3285.36 N -------------

Live load per end panel point = 3285.36/2 = 1642.68 N--

Q.5 (c) Explain the design procedure with formulae and meaning of each term in it to calculate panel point's live load and wind load for steel roof truss.

Ans

Live load:- IS 875 part-ii makes the following provisions for live loads for the design of sheets and purlins.
Up to 10^0 slope :0.75N/m^2
For more than 10^0 slope :0.75-0.02(θ-10) where, θ –slope of sheeting.
However,a minimum of 0.4 kN/ N/m^2 live load should be consider in any case.
For the design of trusses the above live load may be reduced to 2/3.
The purlins and sheets should be checked to support a concentrated load of 0.9 KN.

Live load per intermediate panel point = Live load per m^2 x plan area of roof per panel point--- — 4M

wind load:design steps to calculate wind load on roof truss as per IS-875-1987:

1. Design wind speed (Vz)=k1 k2 k3 Vb

i. Risk Coefficient-(**k1)**
ii. Terrain ,Height And Structure Size Factor, **k2**
iii. Topography Factor. **k3**

iv. basic wind speed -Vb

2. wind pressure (Pz)=0.6 (Vz)2----(N/m^2)

3. wind load on roof

F = (Cpe - Cpi)Apz

Cpe - Coefficient of external wind pressure

Cpi - Coefficient of internal wind pressure

A - surface area of structural element in (m2)

pz - design wind pressure **(N/m^2)**

--- 4M

Q.6 (a) Enlist any four components of plate girder and write their functions.

Ans

components of plate girder:

components	**Function**
a)web plate	Keep flanges at required distance. Resist the shear in the beam.
b)flange plate	Provided to resist bending moment acting on the beam by developing compressive force.
c)end posts or bearing stiffeners	Stiffeners are provided to safeguard the web against local buckling failure
d)intermediate transverse stiffeners	
e)longitudinal stiffeners	
f)web splices	For providing additional length and strength.
g)flange splices	

01 M each

Q.6 (b) State the design steps for rolled steel beam when it is laterally restrained

Ans

STEP NO.1 calculate max. Bending moment and shear force i.e. (**M &V** resp.) From factored load. 04 M

STEP NO.2 OBTAINED SECTION MODULUS $(Z_p)_{required.}(Z_p)_{required.} = f_y \times M / \gamma_{mo}$ $\gamma_{mo} = 1.1$

STEP O.3 select suitable section so that $(Z_p)_{provided} > (Z_p)_{required.}$

step no.4 check the section classification from **b/t_f and d/t_w**

step no.5 calculate design shear for web

$Vd = f_y D t_w / 1.732\ \gamma_{mo}$ check Vd > V AND V <O.6 V_d

step no.6 calculate moment resisted by the section

$Md = \beta_b (Z_p) f_y / \gamma_{mo}$ $\beta_b = 1$ for plastic section and compact section

$\beta_b = (Z_p)_{required.} / (Z_p)_{provided}$

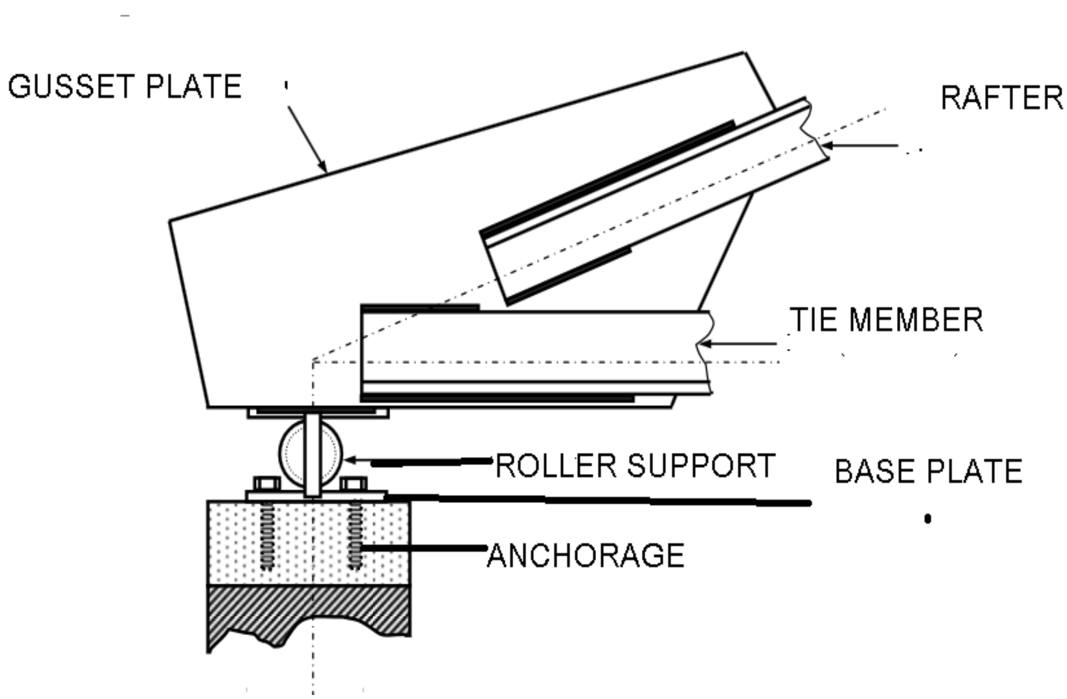
for plastic section and compact section

step no.7 check for deflection i.e maximum deflection of service load < permissible values given

Step no.8 check for web buckling.

Q.6 (c) Draw a neat sketch showing the main tie member at support having free to slide horizontally.

Ans



04 M

Q.6	(d) Ans.	State the effective length for a compressive member having end conditions are 1. Restrained against translation and free against rotation at both ends. 2. Restrained against translation and free against rotation at one end but roller support at other end.	

End conditions	effective length	Marks
1.Restrained against translation and free against rotation at both ends	1.0 L	02 M
2. Restrained against translation and free against rotation at one end but roller support at other end.	1.2 L	02 M

Q.6	(e) Ans.	State the classification of cross section of beams based on moment rotation behavior. Classification of c/s of beam based on moment – rotation behaviour as per IS 800-2007 1. Class 1 – Plastic 2. Class 2 – Compact 3. Class 3 – Semi compact 4. Class 4 – Slender	**01 M** for each