

B.E. (Civil Engineering) Sixth Semester (C.B.S.)
Steel Structures - I

P. Pages : 3

Time : Four Hours



TKN/KS/16/7463

Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
 2. Solve Question 1 OR Questions No. 2.
 3. Solve Question 3 OR Questions No. 4.
 4. Solve Question 5 OR Questions No. 6.
 5. Solve Question 7 OR Questions No. 8.
 6. Due credit will be given to neatness and adequate dimensions.
 7. Assume suitable data whenever necessary.
 8. Use of non programmable calculator is permitted.
 9. Use of structural steel table and I.S. 800-2007 is permitted.

1. a) Determine the shape factor and the plastic moment of Resistance about the centroidal x-x-axu for the section shown in figure 1. Take $f_y = 250\text{N/mm}^2$. 6

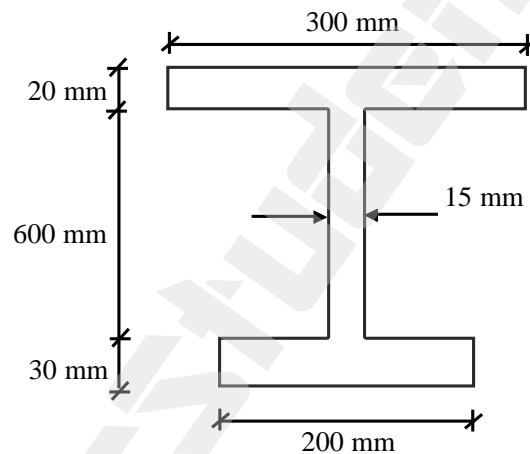


Figure 1

- b) Design a single Angle Tie Member to Carry a safe load of 150kN. The length of member is 2.5m. Provide bolted connection. 14

OR

2. a) A 2.5m Long discontinuous strut is subjected to a factored load of 300kN. Design the section using two angles provided on either sides of the gusset 15mm thick. Use Bolted connection. 14
- b) Find the collapse load for the beam loaded as shown in figure 2. 6

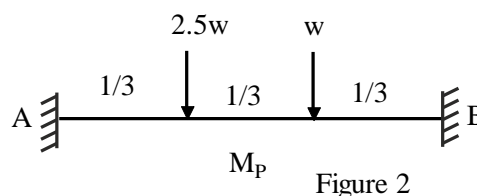
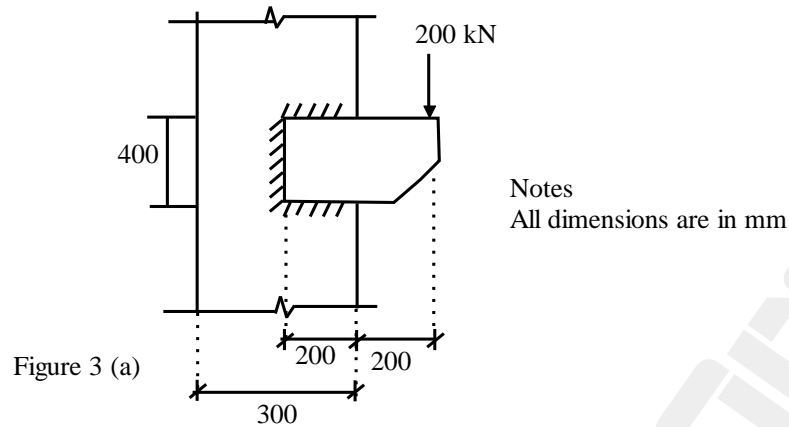
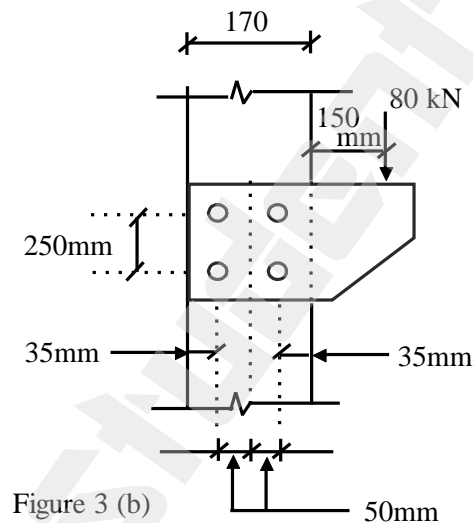


Figure 2

3. a) Design a Bracket connection to transfer a factored Load of 200kN as shown in figure 3 (a). **10**



- b) A bracket connection is shown in figure 3 (b). Find the size of Bolt required if thickness of the bracket is 12mm. **10**



OR

4. a) A secondary Beam ISLB 350 @ 49.5 kg/m is to be connected to a main Beam. ISMB 600 @ 122.6 kg/m. The secondary beam transfers a safe reaction of 400 kN. Design the connection. **10**
- b) Design a welded seat angle connection between a beam ISMB 350 @ 49.5 kg/m and column ISHB 225 @ 46.8 kg/m. for a reaction of Beam 150 kN assuming Fe410 grade of steel with $f_y=250$ MPa and welding is done at site. **10**
5. A beam, simply supported over an effective span of 8m, carries a U.d.L. of 80 kN/m, inclusive of self weight. The depth of the beam is restricted to 450 mm. Design the Beam assuming that the compression flange of the beam is laterally supported by floor construction. Assume width of support 230 mm. **20**

OR

6. A welded plate Girder of span 30m is Laterally restrained throughout its length. It has to carry a load of 110 kN/m over the whole span besides its self weight. **20**
Design.
i) C/s of Girder.
ii) End Bearing stiffener and
iii) Connection of flange to web.

7. Design a Built up column consisting of four rolled steel angles of Grade Fe410 steel for a 5m high Laced column to carry a factored Load of 2000 kN. The column is effectively held in position but not restrained against rotation at both ends. **20**

OR

8. a) A column is subjected to a factored load of 1000 kN and a factored moment of 80 kN-m @ one of its planer axes and 40 kN-m about the other axis respectively. Design the section using single rolled section if its effective length is 5m. **10**
- b) Design the Base plate for the column with section ISHB 225 @ 46.8 kg/m to carry a factored load of 900 kN. Assume Fe410 grade steel and M25 concrete. **10**

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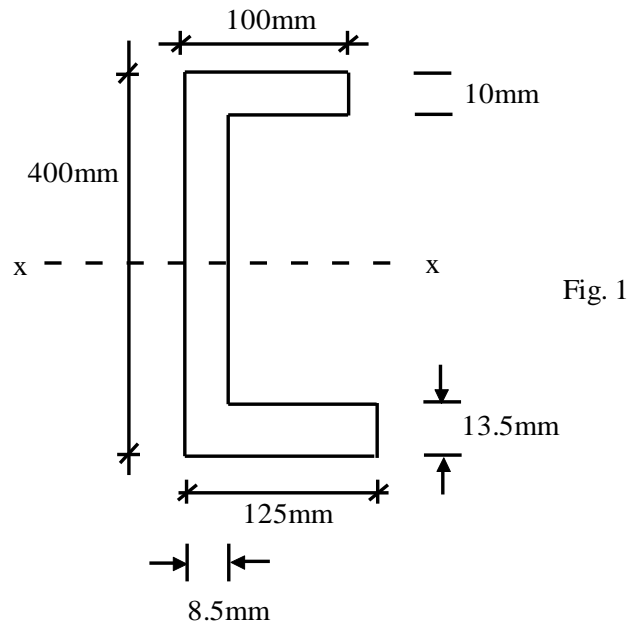


NKT/KS/17/7375

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 7. Illustrate your answers whenever necessary with the help of neat sketches.
 8. Use of non programmable calculator is permitted.
 9. Use of structural steel table and IS 800: 2007 is permitted.

1. a) Determine the plastic section moduli and the plastic moment capacity of the channel section shown in Fig. 1 about x-x axis. Assume $f_y = 250 \text{ N/mm}^2$. 7



- b) A tension member is subjected to a factored load of 275kN. Design the section using two angles provided on same side of gusset plate. Length of the member is 2.5m. Provide bolted connection. 13

OR

2. a) Find the value of W at collapse for the fixed beam of uniform section as shown in Fig:2. 7

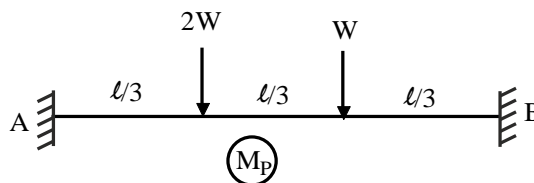
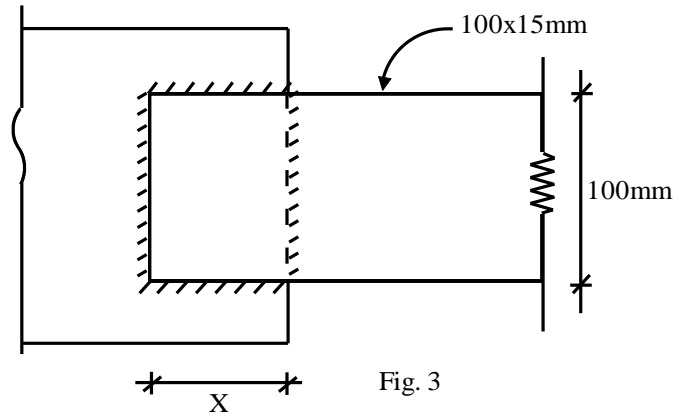


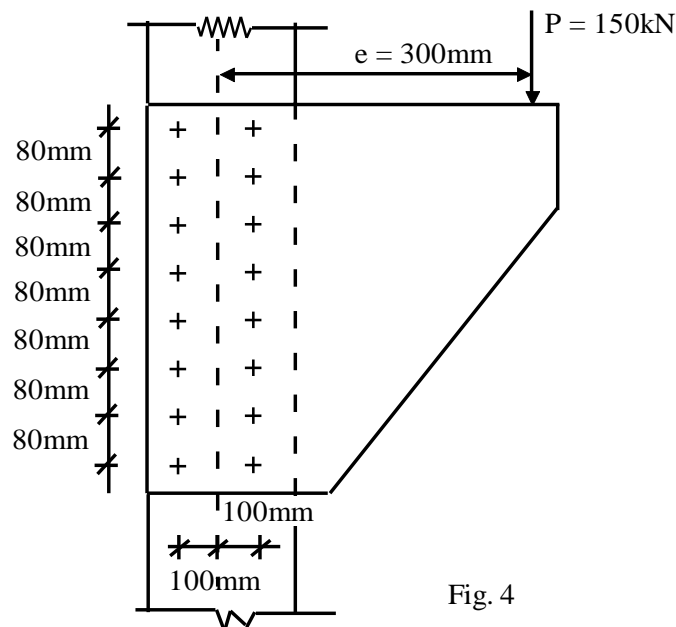
Fig. 2

- b) Design a single angle discontinuous strut 3m long between intersections. The service load acting on the member is 80kN. Provide welded connection. Use E250 (Fe410W) B grade steel. **13**

3. a) A tie FLAT 100mm×15mm is welded to another plate as shown in Fig:3. It is subjected to a factored pull of 300kN. Find the minimum overlap required if 8mm fillet welds are used. **8**



- b) A working load of 150kN is applied to a bracket plate at an eccentricity of 300mm. The bolts are arranged as shown in Fig: 4. The thickness of the bracket plate is 12.0mm. Investigate the safety of the design.



OR

4. a) Design a welded stiffened seat angle connection to connect a beam ISMB 400 to flange of a column ISHB 200. The reaction transferred from the beam is 250kN. Assume E250 (Fe410W) C grade steel. **10**

- b) Design a splice connection for an ISMB 400 to transfer a factored bending moment of 120kNm and factored shear of 80kN. Use ordinary bolts of grade 4.6. and E 300 (Fe 440) grade steel. **10**

5. A simply supported beam of clear span 5.5m is supported on 250mm wide end bearings. The beam has to carry a service udl of 45kN/m excluding its own weight. Design the beam if it is laterally supported. **20**

OR

6. A girder of span 24m is carrying a superimposed service load of 60kN/m throughout its length and a concentrated load of 400kN acting at its mid span. The compression flange of the girder is restricted from moving laterally. Design the girder if only 8mm, 10mm and 12mm thick plates are available. Provide welded connection. **20**
7. Design a built-up column using two channels arranged face to face to resist a service load of 800kN. The length of the column is 8.0m which is effectively held in position at both ends but not restrained against rotation at one end. Use single lacing system and bolted joint. **20**

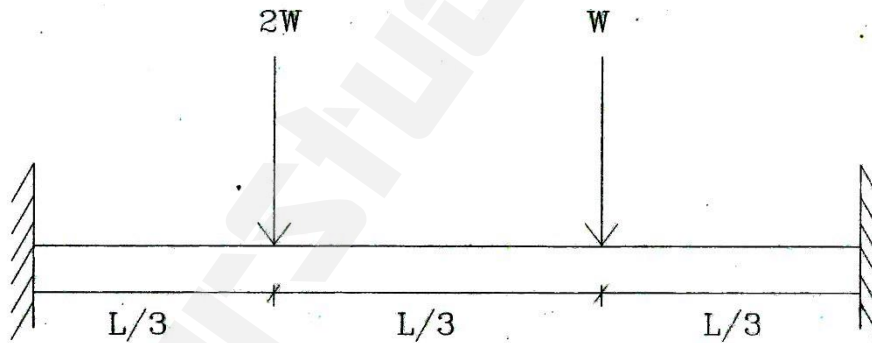
OR

8. Design an I section beam-column of length 4m as a ground floor column in a multistorey building. The frame is moment resisting in-plane and pinned out of plane, with diagonal bracing provided in both directions. The column is subjected to major axis (z-z) bending due to horizontal forces and minor axis (y-y) bending due to eccentricity loads. Take factored axial load = 750kN, factored moments: at the top of column: $M_z = 150\text{kNm}$, $M_y = 100\text{kNm}$ at the base of column: $M_z = -150\text{kNm}$, $M_y = 0$ Use Fe410 grade steel. **20**

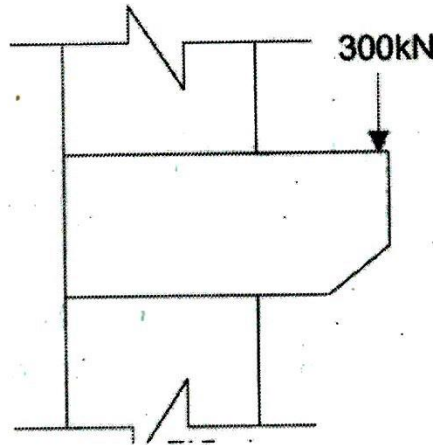


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 5. Solve Question 7 OR Questions No. 8.
 6. Use of IS 800 : 2007 is permitted use of steel table is permitted.

1. a) Design a single Angle Tie Member to carry a service load of 125 kN Tension. The length of member is 2.8 m. Provide bolted connection. **10**
 - b) Determine the shape factor and plastic moment of resistance about centroidal x-x axis for an I-section having Top flange 150×20 mm, bottom flange 220×20 mm & web 8×450 mm. **10**
- OR**
2. a) Design a compression member using 2 angles back to back on each side of gusset plate 8mm thick for a factored load of 210 kN. Centre to center length of member is 3m. Design bolted connection. **10**
 - b) Find the collapse load for the beam as shown in fig. **10**



3. a) A bracket Plate connected to flange of a column ISHB 350 @ 0.674 kN/m through 16 mm diameter bolts is subjected to a factored load of 350 kN at an eccentricity of 300mm from center line of web of column as shown in figure Assume the load plane and bolt plane being the same. Design the connection. **10**



- b) A double cover butt joint, with bolts arranged in chain pattern is to be provide for connecting two tie bars in steel grade Fe 410, each 240mm wide and 22 mm thick. Design the joint and determine the strength and efficiency of joint. **10**

OR

4. a) Design a bolted seated connection between a beam ISMB 500 and column ISHB 300 for a factored reaction of beam 180 kN. Use E 250 (410) A grade type steel. Also use 4.6 grade bolts. **10**

- b) Design welded splice for an ISMB 450 to transfer a factored bending moment of 125 kN-m and factored shear force of 80 kN. Assume that the flange splice will carries bending moment and web splice carries only shear. **10**

5. Design a laterally restrained simply supported steel beam of effective span of 6m subjected to working U.D.L of 55 kN/m over entire span inclusive of self weight. Assume width of support is 230mm. Do all necessary checks. **20**

OR

6. A welded plate girder of span 30m is laterally restrained throughout its length. If has to carry a load of 110 kN/m over the whole span be sides its self weight. Design. **20**

- 1) C/s of Girder.
- 2) End Bearing stiffener and
- 3) Connection of flange to web.

7. Design a Built up column consisting of four rolled steel angles for a 5m high Laced, column to carry a factored Load of 2000 kN. The column is effectively help in position put not restrained against rotation at both ends. **20**

OR

8. a) A column is subjected to factored load of 1000 kN and a factored moment of 80 kN-m @ one of its planer axes and 40 kN-m about the other axis respectively. Design the section using single rolled section if its effective length is 5m. **10**

- b) A column carries a factored load of 1200 kN. The column has an effective length of 6m. Design the base plate to support the column. Use M20 grade of concrete. **10**

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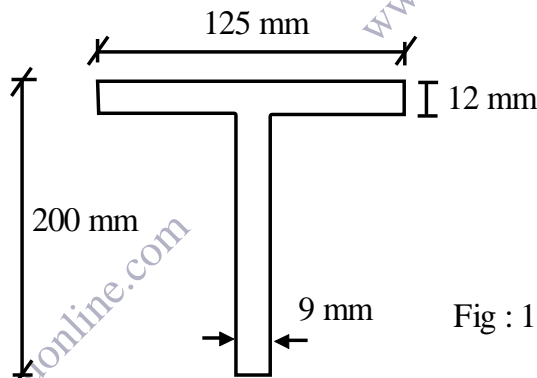


KNT/KW/16/7375

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 6. Assume suitable data whenever necessary.
 7. Diagrams should be given whenever necessary.
 8. Illustrate your answers whenever necessary with the help of neat sketches.
 9. Use of non programmable calculator is permitted.
 10. Use of IS 800-2007 and steel table is permitted.

1. a) A 3m long member is carrying a service tensile load of 325kN. Design the member using two angles provided on same side of gusset plate. Provide bolted connection. Use E250 (410) B grade steel and ordinary bolts of grade 4.6. 12
- b) Find the shape factor and plastic section modulus of the section shown in Fig: 1 8



OR

2. a) Design a single angle discontinuous strut to carry a working load of 150kN. Length of the member between intersections is 2.9m. Use welded connection and $\epsilon 250(410)A$ grade steel. 12
- b) Determine the collapse load of the propped cantilever loaded as shown in fig : 2. 8

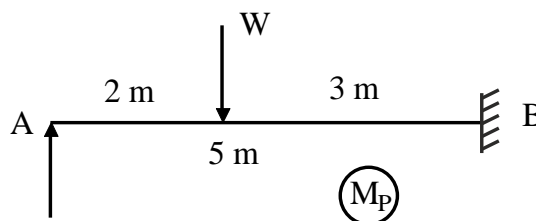


Fig : 2

3. a) An ISF 180 × 16 mm is bolted to a gusset plate 16 mm thick by a double cover butt joint with 20 mm diameter bolts as shown in fig: 3 Find design strength of the member and its efficiency.
 Take $f_y = 250 \text{ MPa}$
 $f_u = 410 \text{ MPa}$

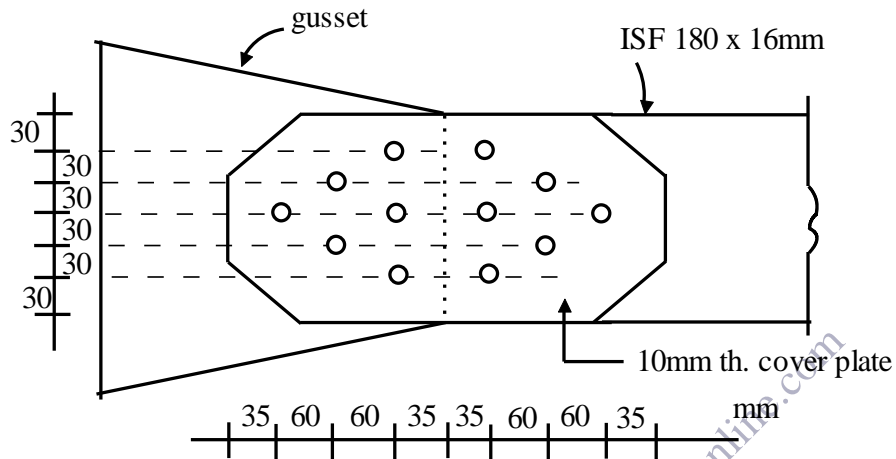


Fig.3

- b) A bracket connection is shown in fig : 4. Find the size of the bolt required if thickness of the bracket plate is 10 mm. 10

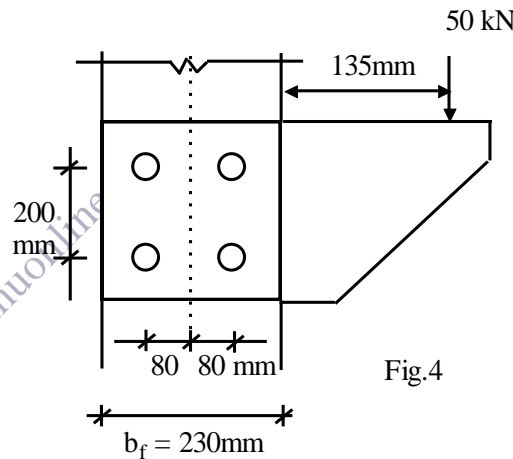


Fig.4

OR

4. a) A beam ISMB 400 transfers a factored reaction of 275 kN to a supporting column flange ISHB 200. Design a stiffened seat angle connection. Use bolts of grade 4.6. 10
- b) Design a welded splice for an ISMB 400 to transfer a factored bending moment of 150kNm and a factored shear of 100kN. Assume that the flange splice carries all the moment and web splice carries only the shear. 10

5. A beam of clear span 4.5 m is simply rested over the end bearings 200 mm wide. It carries a service udl of 20 kN/m. Design the beam if its lateral movement is not restricted. **20**

OR

6. Design a welded plate girder using E250 (Fe410w) A grade steel. The effective span of the girder is 25m. It carries a service udl of 50 kN/m and a point load of 400kN at mid span. Assume the girder to be laterally supported. **20**
7. Design a built up column using two channels face to face. The effective length of the member is 8.0 m and is subjected to a factored load of 1100 kN. Assume Fe410 grade steel. Also design battens. **20**

OR

8. a) Design a gusseted base to support ISHB 400 @ 77.4 kg/m carrying a factored axial load of 2000 kN. Use bolted connection. The design bearing strength of the concrete pedestal is 10 N/mm^2 . **8**
- b) A beam-column of effective length of 6 m carries a service axial load of 450 kN and equal end moments of 50 kN-m each about the major axis. Design the member using single rolled section. Assume that the sway of the member is prevented and the column bends either in single or in double curvature. **12**

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NRJ/KW/17/4514

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 5. Solve Question 7 OR Questions No. 8.
 6. Assume suitable data whenever necessary.
 7. Illustrate your answers whenever necessary with the help of neat sketches.
 8. Use of non programmable calculator is permitted.
 9. IS 800:2007 and structural steel table is permitted.

1. a) A 2.7m long tie member is carrying an axial service load of 90kN. Design the section using single angle of E250 (Fe 410W) A grade material and provide bolted connection. **13**
- b) Find the shape factor and plastic section modulus of a thin hollow circular section with external diameter 'D', internal diameter 'd' and ring thickness 't'. **7**

OR

2. a) Design a discontinuous strut to carry a factored axial load of 300kN. Length of the member between intersections is 3.0m. Section of the member shall consist two angles provided on either sides of gusset. Provide welded connection. **12**
- b) Find the value of 'W' at collapse for the fixed beam of uniform section shown in Fig:1. **8**

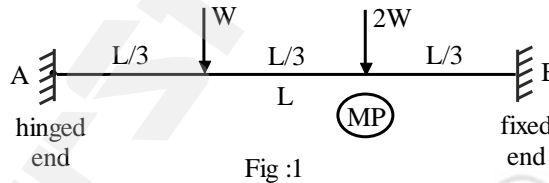


Fig :1

3. a) Find the efficiency of a single bolted lap joint connecting 2 plates of 6mm thickness with 16mm diameter bolts at a pitch of 50mm. Consider ordinary bolts of grade 4.6 and plate of grade 410. **10**
- b) A 150×10mm tie requires a splice within its length. Design a fillet welded connection with a single cover plate, 12mm thick. refer fig:2 **10**

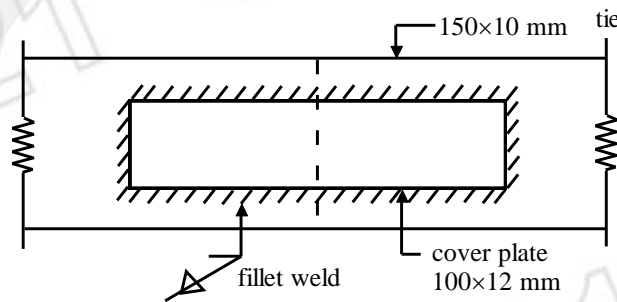
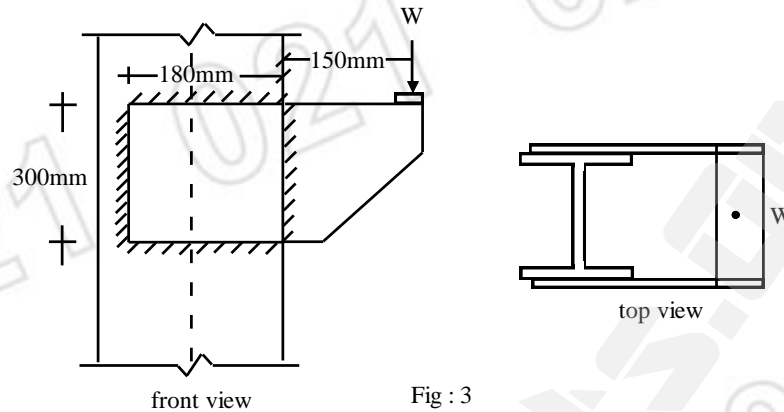


Fig : 2

OR

4. a) Design a bolted web angle connection for a ISMB 450 @ 72.4 kg/m to carry a reaction of 100kN due to service loads. The connection is to the flange of a column ISHB 250 @ 51kg/m. **10**
- b) A bracket consisting of two bracket plates welded to the flanges of an ISHB 225 @ 46.8 kg/m column. The factored load on the bracket is 400kN. Determine the size of weld. refer fig:3 **10**



5. Design a laterally unsupported beam having clear span of 4.5m simply resting over the end bearings 250mm wide. If carries a service udc of 20 kN/m. **20**

OR

6. A girder of effective span 24m is loaded with a service udl of 50 kN/m and two point loads 250kN each at $1/3^{\text{rd}}$ span from each support. Design the cross section of the plate girder, bearing stiffeners, intermediate stiffeners, assuming the girder is laterally restrained. Provide welded connections. **20**
7. Design a built up column using two channels back to back. The length of the member is 7.5m between intersections which is effectively held in position but not restrained against rotation at one end. The factored axial load on the member is 2100kN. Assume Fe410 grade steel. Also design double lacing system using bolted connection. **20**

OR

8. a) A column having effective length of 5.5m carries an axial load of 300kN, alongwith end moments of 50kN-m about major axis and 20kNm about minor axis. Design the member using single rolled section assuming sway of the member is prevented. (consider all loads as service loads). **13**
- b) Design the slab base for an ISHB 300 column to carry a factored load of 1000kN. Assume Fe410 grade steel and M20 grade concrete. **7**
