Unit - I

Syllabus :-

(I) Connections: Riveted connections - definition, rivit strength and capacity, Welded connections Introduction, Advantages and disAdvantages of Welding - Strength of Welds - Butt and fillet welds Permissible stresses - IS Code requirements. Design of fillet weld Subjected to moment acting in the plane and at right angle to the plane of the joints

(II) Unit - II

Beams:- Allowable stresses, design requirements as per code - Design of simple and compound beams - curtailment of the flange plates, Beam to beam connections, check for deflection, shear, buckling, check for bearing laterally unsupported beams.

(III) Unit:-

Design of Columns ~~Foundations~~: Built up Compression members, Design of lacings and ~~beam~~ battens, Design of Eccentrically loaded Columns, Sloping of Columns.

IV :- Design of Column Foundations:- Design of slab base and, gusseted base, Column Base Subjected moment.

V unit

Tension members and Compression members

General Design of Members subjected to direct tension and bending - effective lengths of Columns slenderness ratio - permissible stresses - Design of Compression members, struts etc.

Roof Trusses:- Different types of trusses. Design - loads - load combinations as per IS Code - recommendations. Structural details - Design of single roof stresses involving the design of purlins, members and joints - tubular trusses.

VI - unit

Design of plate Girder:- Design Considerations - IS Code recommendations Design of plate girder - Welded - curtailment of flange plates, Stiffeners - Splicing and Connections.

Design of Gantry Girder:- Impact factors - Longitudinal forces, Design of Gantry girders

Unit – 8

Welding Consists of joining two pieces of Metal by establishing a Metallergical bond between them.

Advantages & DisAdvantages of Welded Connections:-

1) It is possible to achive 100% efficiency in the joint, Than bolted connection & Rivit Connection.
(2) Less noise is produced in Welding process.
3) Welded Connections have good appearence.
(4) Welded joints are rigid.
(5) Welded Connection is "Airtight & Watertight. Hence there is less corrosion of steel structures.
(6) Due to the absence of gusset plates, Connecting angles etc, Welded structures are lighter.
(7) The absence of Making holes for fasteners, Makes Welding process quicker.
(8) Welding is more adaptable than bolting (or riviting)
9) Alternations in Connections can be easily made in the design of Welded Connections.

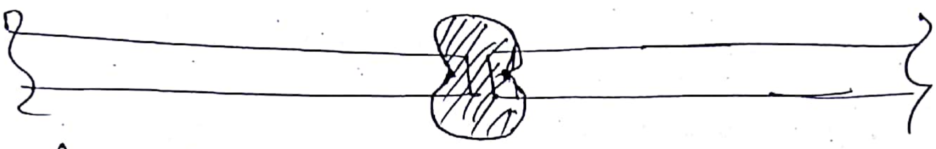
DisAdvantage:-

(1) Due to uneven heating & Cooling; members are likely to distort in the process of Welding.
(2) There is a greater possibility of brittle fracture in Welding.
(3) A welded joint fails earlier than a bolted joint.
(4) The Inspection of Welded joints is difficult and expensive
(5) proper Welding in field Connections is difficult
(6) Welded joints are over rigid.

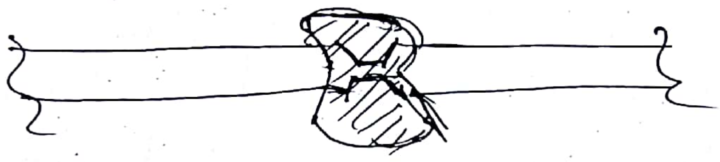
Types of welded joints:-

There are three types of welded joints ~~Butt weld~~
(1) Butt weld. (2) Fillet weld (3) Slot weld (or) plug weld.

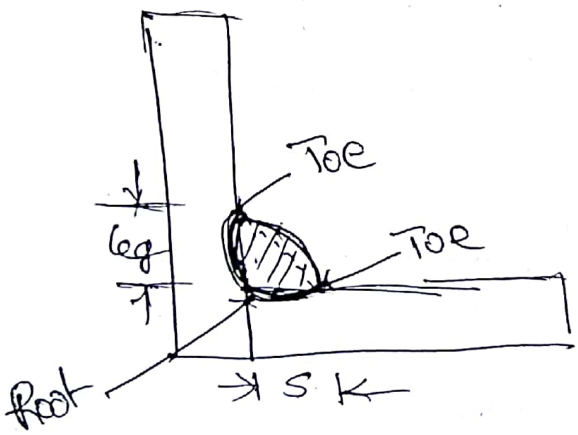
Butt Weld:- It is known as groove weld. Depending upon the shape of the groove made for welding. Butt welds are (1) Square butt weld on both sides.

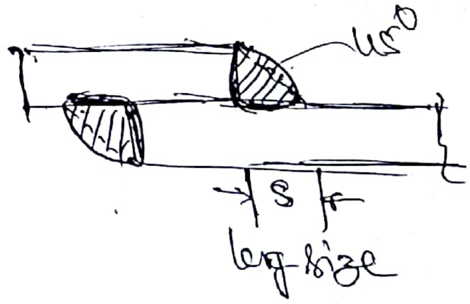


(2) Double V-butt joint



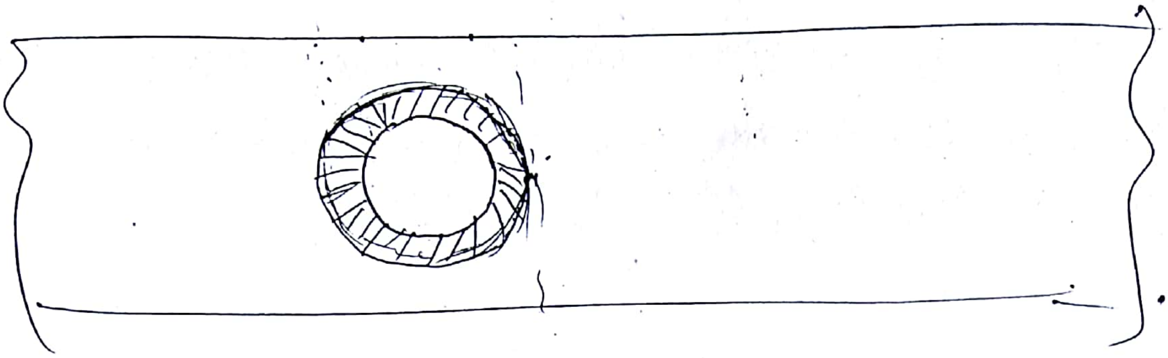
(2) **Fillet weld:-** Fillet weld is a weld of approximately triangular cross-section joining two surfaces approximately at right angles to each other in ~~lap~~ Lap joint., Tee joint & Corner joint



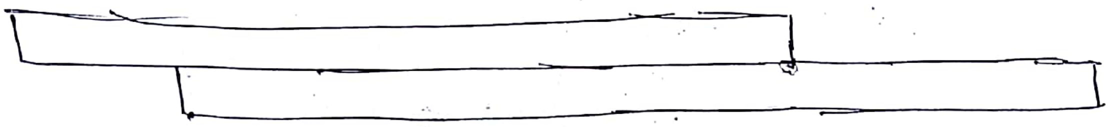


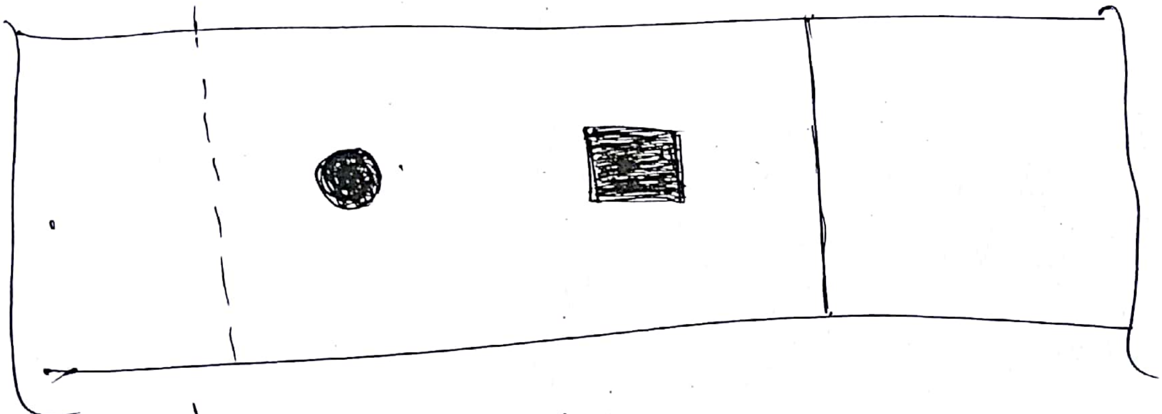
(3) **Slot weld and plug weld.**

Slot weld:. fig shows the slot weld in which a plate with circular hole is kept with another plate to be joined and then fillet welding is made along the periphery of the hole.



plug weld:- ~~Fig~~ Fig shows a typical plug weld in which small holes are made in one plate and is kept over another plate to be connected and then the entire hole is filled with filler material.





Design Stresses in Welds:-

The Design strength shall be based on its throat area and size of weld in all cases,

$$f_{wd} = \frac{f_{wn}}{\gamma_{mw}} \quad \text{where } f_{wn} = \frac{f_u}{\sqrt{3}}$$

f_u = smaller of the ultimate stress of the weld (or) parent metal

γ_{mw} = 1.25 for shop weld
- 1.5 for Field weld.

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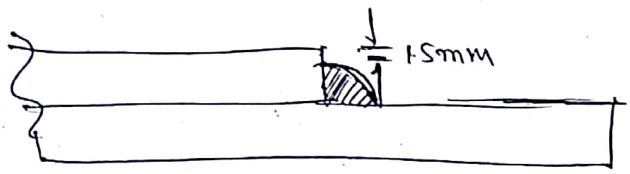
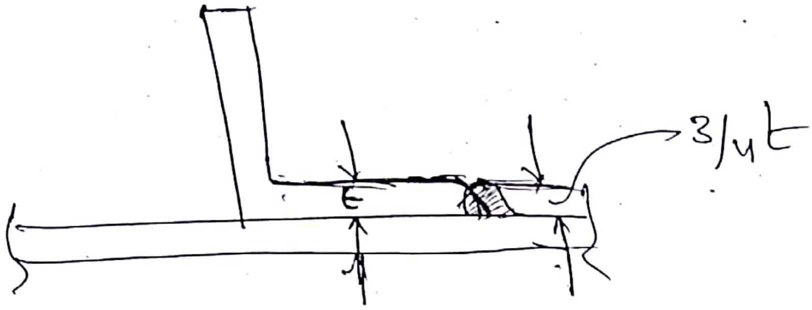
The following provisions are made in the Code for the fillet welds applied to the edge of a plate or section.

1) If a fillet weld is to the square edge of a part. The size of the weld should generally be at least 1.5 mm less than the edge thickness.



(2) If fillet weld is to the round toe of a rolled section, the specified size of the weld should generally not exceed "3/4 t" of the section at the toe.



Q) A 18mm thick plate is joined to a 16mm plate by 200mm long effective butt weld. Determine the strength of joint if

i) A Double V butt weld is used

ii) A single V butt weld is used

Assume that Fe 410 grade plates and shop welds are used.

<u>Solution</u>:-

Case-I (Double V. butt weld joint)

Since in such case complete penetration takes place, throat thickness = Thickness of thinner plate.

$t = 16$ mm.

effective length $= L_w = 200$ mm.

$f_u = 400\ N/mm^2$; Shop weld $\gamma_{mw} = 1.25$

Effective area of weld = effective length × throat thickness

$= L_w \times t$

$\therefore$ Design strength of weld $= \dfrac{A_g \times f_u/\sqrt{3}}{\gamma_{mw}} = \dfrac{L_w \times t \dfrac{f_u}{\sqrt{3}}}{\gamma_{mw}}$

$$f_{wd} = \frac{200 \times 16 \times \frac{415}{\sqrt{3}}}{1.25} = 605,687\ \text{N}$$

$f_{wd} = 605.687\ \text{KN}$

Case – II Single butt weld joint

Since penetration is not Complete — effective throat thickness $= t = \frac{5}{8} \times t$

$$t = \frac{5}{8} \times 16 = 10\text{mm}$$

$$\text{Design strength} = \frac{L_e \cdot t \cdot \frac{f_u}{\sqrt{3}}}{\gamma_{mw}}$$

$$f_{wd} = \frac{200 \times 10 \times \frac{410}{\sqrt{3}}}{1.25} = 378742\ \text{N}$$

$f_{wd} = 378.742\ \text{KN}$

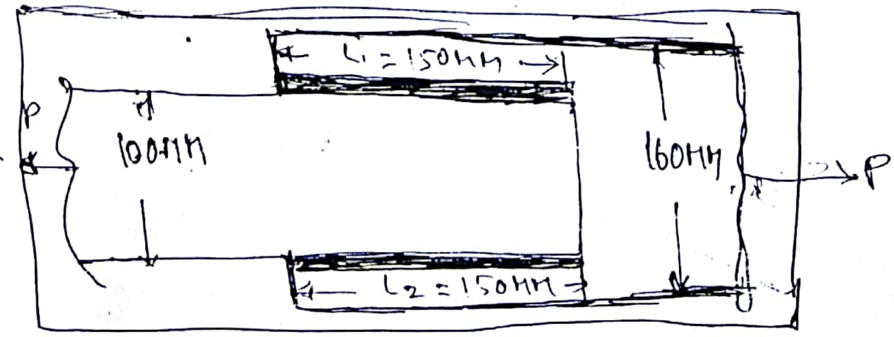
Q Design a suitable longitudinal fillet weld to connect the plates as shown in fig to transmit a pull equal to the full strength of small plate. Given plates are 12mm thick grade of plates Fe 410 and welding to be made in work shop.

Solution:-

Minimum size of weld to be used $= 5\text{MM}$

Maximum size $= t - 1.5$

$= 10.5\text{mm}$



Use Size of Weld = S = 10 MM Fillet Weld.

$f_u = 410\ N/MM^2$, $\gamma_{mw} = 1.25$, Thickness of plate = 12 MM.
breadth of plate = 100 MM.

$\therefore$ Full design strength of Smaller plate = $\frac{A_g f_y}{\gamma_{mo}}$

Assume $f_y = 250$ Mpa (or) 250 N/MM^2

$\gamma_{mo} = 1.1$, A_g = Area of Welded plate = $12 \times 100 = 1200\ MM^2$

$\therefore$ Full design strength of Smaller plate = $12 \times 100 \times \frac{250}{1.1}$

$= 272727\ N$.

let effective length of Weld = L_w. ($t = 0.7 S$)

Assuming normal weld throat thickness = $t = 0.7 \times 10 = 7mm$.

$\therefore$ Design Strength of Weld = $L_w \times t \frac{f_u}{\sqrt{3}} \times \frac{1}{\gamma_{mw}}$.

$f_{wd} = L_w \times 7 \times \frac{410}{\sqrt{3}} \cdot \frac{1}{1.25}$

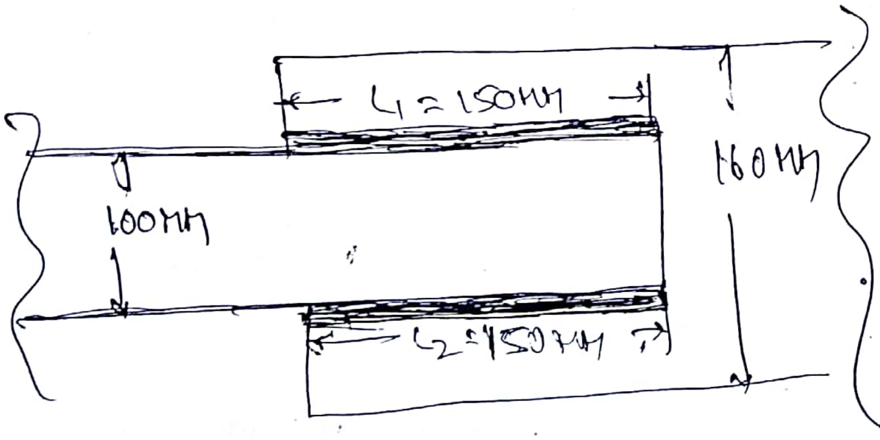
Equating it to the strength of plate, we get

$272727 = L_w \times 7 \times \frac{410}{\sqrt{3}} \times \frac{1}{1.25}$

$L_w = 205.7mm \simeq 300\ MM$.

provide effective length on each side = $\frac{300}{2}$

$L_1 = 150\ MM$,
$L_2 = 150\ MM$. as shown fig.



Q. A Tee member of a roof truss consist of 2 ISA 100×75 8mm. thick. The angles are connected to either side of a 10mm gusset plates and the member is subjected to a working pull of 300 kN. Design the welded connection. Assume connections are made in the workshop.

Solution:— Use of angle = ISA 100×75×8 mm.

Working load = 300 kN

∴ Factored load = 300×1.5 = 450 kN.

or = 450×10^3 N.

① Thickness of weld.

a) At the rounded toe of the angle section, size of weld should not exceed } = $3/4 \times t$

$S = 3/4 \times 8 = 6$ mm.

(b) At top the thickness should not exceed = t − 1.5

$S = 8 - 1.5 = 6.5$ mm.

Hence provide S = 6mm weld.

Each angle carries a factored pull of $\frac{450}{2} = 225$ kN

Let L_w be the length of weld required.

Assuming normal weld t = 0.7 S = 0.7×6

② ∴ Design strength of the weld = $L_w \times t \cdot \frac{f_u}{\sqrt{3}} \times \frac{1}{\gamma_{mw}}$

Assume grade plates = Fe410.

$f_u = 410$; t = 0.7×6, $\gamma_{mw} = 1.25$

$f_{wd} = L_w \times 0.7\times6 \times \frac{410}{\sqrt{3}} \times \frac{1}{1.25} =$

∴ Design strength of weld = Pull

$f_{wd} = P$

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$225 \times 10^3 = L_w \times 0.7 \times 6 \times \frac{410}{\sqrt{3}} \times \frac{1}{1.25}$

$L_w = 283\,mm$

From steel tables ISA 100×75×8MM, Cg = 31MM from top

Let L_1 be the length of top weld and L_2 be the length of Lower weld. To make centre of gravity of weld to coincide with the angle, taking moment about c.g

$L_1 + L_2 = 300$ — (1)

$L_1 \times 31 = L_2 \times (100-31)$

$(L_1 \times 31) = (L_2 \times 69)$

$L_1 = \frac{69}{31} L_2$ — (2)

$L_1 + L_2 = 300$ — (1)

we get Substitute the value of L_1 in eqn (1)

$\frac{69}{31} L_2 + L_2 = 300$ ✓

$2.2 L_2 + L_2 = 300$ ✓

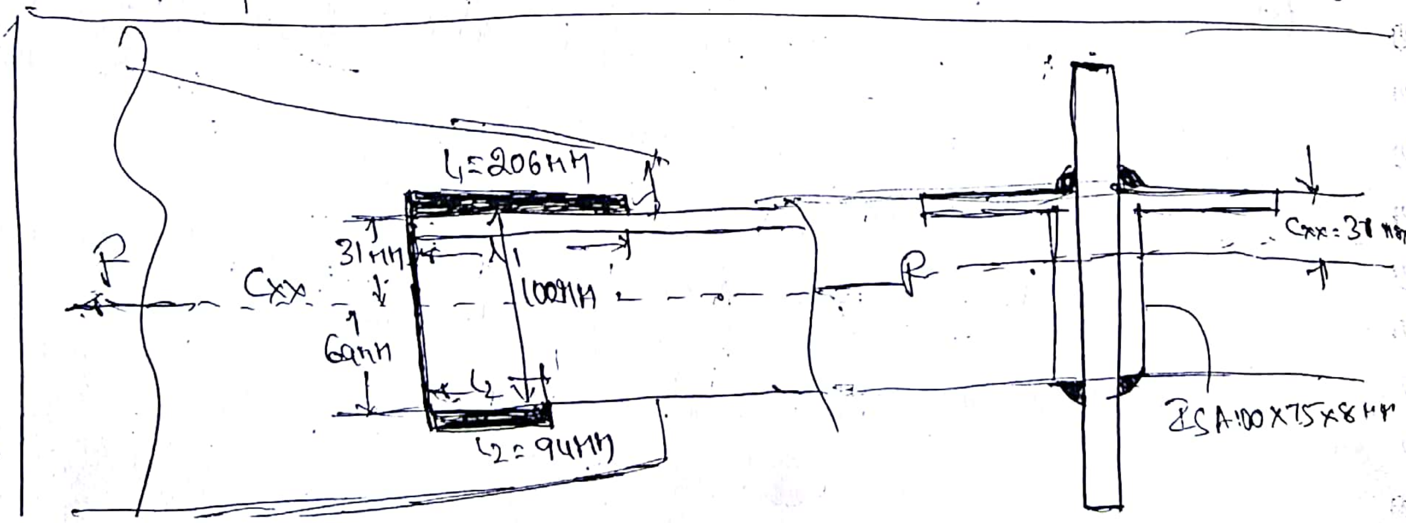
$3.2 L_2 = 300$

$L_2 = \frac{300}{3.2} = 93.75 \approx 94\,mm$

$L_1 + L_2 = 300$

$L_1 = 300 - L_2 = 300 - 94 = 206\,MM$

$L_1 = 206\,mm$; $L_2 = 94\,MM$. as shown in fig



Q. An angle ISA 130 X 130 X 10 mm carrying an axial load of 220 kN is connected to a gusset plate 12 mm thick. Design the welded connection with side and end welds. If the ultimate shear stress the weld is 410 MPa. Assume connection.

Solution:-

Problem:- Use ISA 100 X 100 X 8 mm angle & 400 kN factored load, 12 mm gusset plate, use fu 410 MPa & shop weld. Design front and sides weld.

1) Size of weld.

Thickness of angle leg = 8 mm.

Maximum permitted size of weld = $3/4 \times 8 = 6\,mm$.

Adopt 6 mm size fillet weld.

2) Factored tension = 400 kN = 400×10^3 N

The tie member of a roof truss consists of 2 ISA angles.

Factored load on each angle = $\frac{400\,kN}{2}$ = 200 kN or 200×10^3 N

3) Ultimate shear stress in the weld = f_u = 410 MPa

4) For fillet welds at site

∴ partial safety factor γ_{mw} = 1.5

5) Design stress in the weld = f_{wd}.

$$f_{wd} = \frac{f_u}{\sqrt{3} \times \gamma_{mw}} = \frac{410}{\sqrt{3} \times 1.5} = 157.81\,MPa$$

6) Effective length of weld required = l

$$l = \frac{\text{Factored load (Design load)}}{0.7 \times S \times f_{wd}}$$

(or) $P_{dw} = 0.7 S f_{wd} \times l$

$$l = \frac{200 \times 10^3}{0.7 \times 6 \times 157.81}$$

$= 301.75\,mm \approx$ ~~310 mm~~ 400 mm

(7) Design of joint using fillet welds (side welds only)

For ISA 100 × 100 × 8

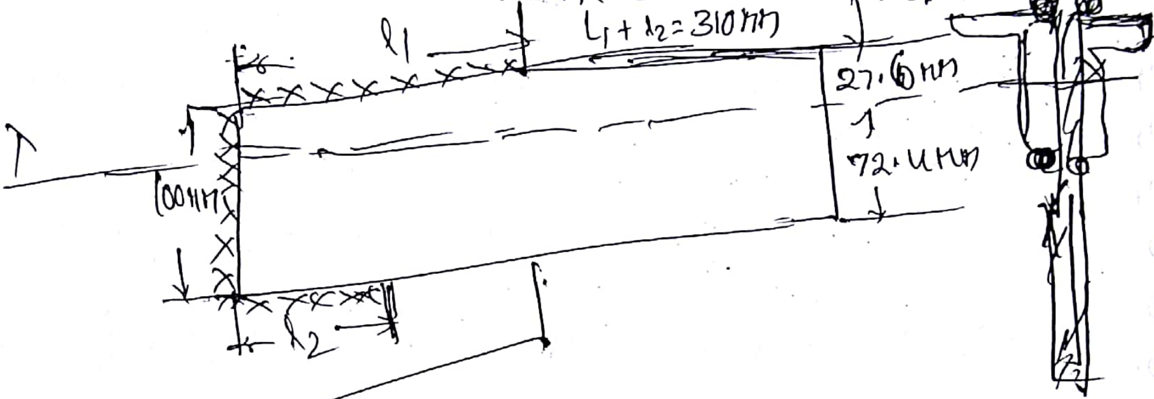
$C_{xx} = 27.6\,mm$ from steel tables.

Let the effective length of side welds be l_1 & l_2

$l_1 + l_2 = 310$ —— (1)

Front weld $= l + l_1 + l_2 = 410\,mm$

$l_1 + l_2 = 400 -$ ~~100~~ $410 - 100 = 310\,mm$



To make centre gravity of weld to coincide with that of angle.

$l_1 \times 27.6 = l_2 \times 72.4$

$l_1 = l_2 \times \frac{72.4}{27.6} = 2.633\,l_2$ —— (2)

from (1) & (2) we get

$2.623\,l_2 + l_2 = 310$

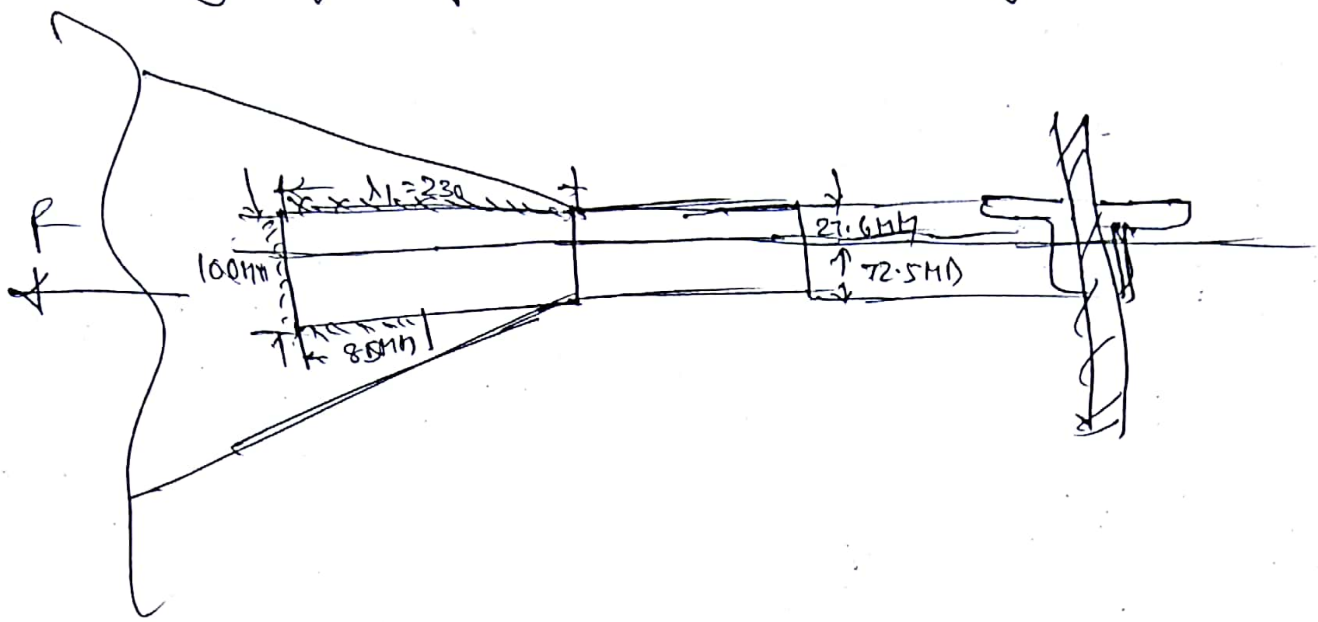
$l_2 = \frac{310}{3.623} = 85.5\,mm$

$l_2 + l_1 = 310$

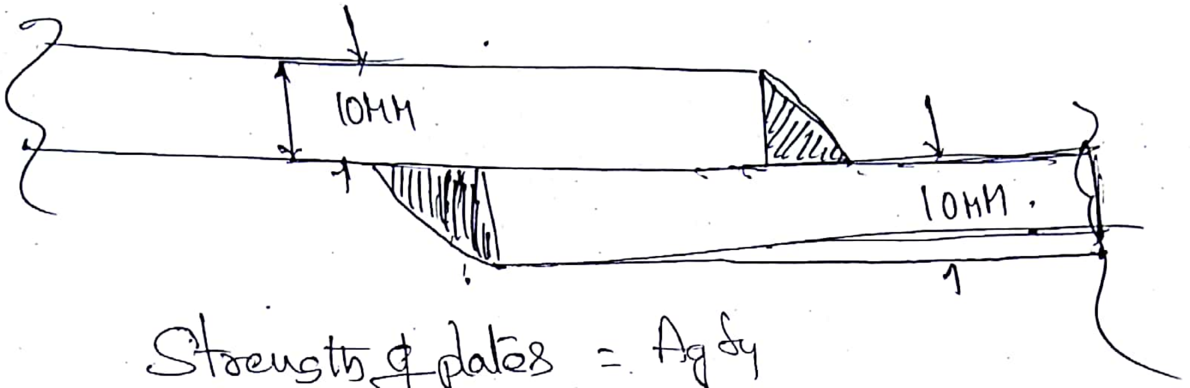
$l_1 = 310 - l_2 = 310 - 85.5 = 224.45\,mm$

∴ The effective lengths of side welds be 230 mm & 85 mm

For safety purpose prove Front welding throughout width (or) length of the plate as shown in fig



Q Design the Welded Connection to Connect two plates of width 200 mm and thickness 10 MM for 100% efficiency.



Strength of plates $= \frac{A_g f_y}{\gamma_{mo}}$

Assume $f_y = 250 N/MM^2$

$\gamma_{mo} = 1.1$

$A_g = 10 \times 200$ MM.

Strength of plates $= \frac{200 \times 10 \times 250}{1.1} = 454545$ N

Minimum size of Weld = 5MM

Maximum Size = $t - 1.5 = 10 - 1.5 = 8.5$ MM

Use 8mm size Weld

Effective length of fillet weld $= 2(200 - 2s)$

$L_w = 2(200 - 2 \times 8) = 368$ MM

Throat thickness $= t = 0.7 \times 8$

Design Strength $= L_w \times t \times \frac{f_u}{\sqrt{3}} \times \frac{1}{\gamma_{mw}}$

Use Fe410 plates & Shop Welding

$f_u = 410$ & $\gamma_{mw} = 1.25$

$f_{wd} = 368 \times 0.7 \times 8 \times \frac{410}{\sqrt{3}} \cdot \frac{1}{1.25}$

$f_{wd} = 390256$ N.

∴ Slot Welds are to be provided to resist a force of

$= 454545 - 390256 = 64289 \text{ N}$,

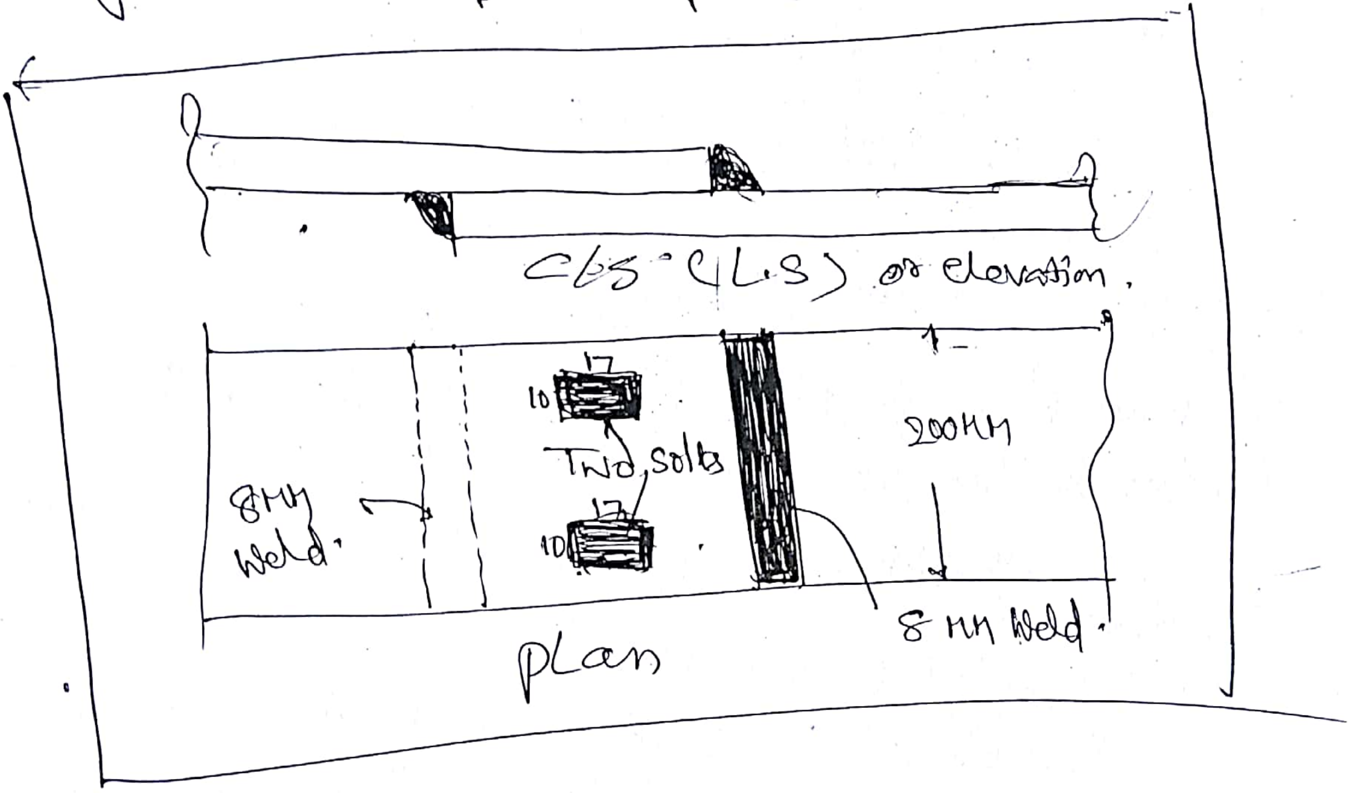
Strength of the slot $= \frac{f_{wn}}{\gamma_{mw}} = \frac{f_u}{\sqrt{3}\,\gamma_{mw}}$

$= \frac{410}{\sqrt{3} \times 1.25} = 189.37 \text{ N/mm}^2$

∴ Area of the slot weld required $= \frac{64289}{189.37} = 339.5$

$A_{slotweld} = 339.5 \text{ mm}^2 \simeq 340 \text{ mm}^2$

Provide two slot welds of size 10mm × 17mm as shown in



Q A tie member consists of two ISMC 250. The channels are connected on either side of a 12mm thick gusset pl. Design the welded joint to develop the full strength of the tie. However the overlap is to be limited to 400mm. Use slot weld if required

Solution

For ISMC 250 From steel tables

Thickness of Web = 7.1 mm

Thickness of flange = 14.1 MM

Sectional area = 3867 mm²

Tensile design strength of each channel = $\frac{A_g f_y}{\gamma_{m0}}$ =

$= \frac{3867 \times 250}{1.1} = 878864\,N$

(2) Design of weld thickness

Minimum thickness = 3mm

Maximum thickness = $t - 1.5 = 7.1 - 1.5 = 5.6$ mm

provide $s = 4$mm weld.

∴ Throat thickness = $t = 0.7 \times s = 0.7 \times 4 = 2.8$mm.

(3) Strength of weld : (Per unit length)

Weld strength = $L_w \cdot t \cdot \frac{f_u}{\sqrt{3}} \times \frac{1}{\gamma_{mw}}$.

$= L_w \times 2.8 \times \frac{410}{\sqrt{3}} \times \frac{1}{1.25} =$

Equating strength of weld to tensile strength of the channel we, get

$878804 = L_w \times 2.8 \times \frac{410}{\sqrt{3}} \times \frac{1}{1.25}$

∴ $L_w = 1658$ mm

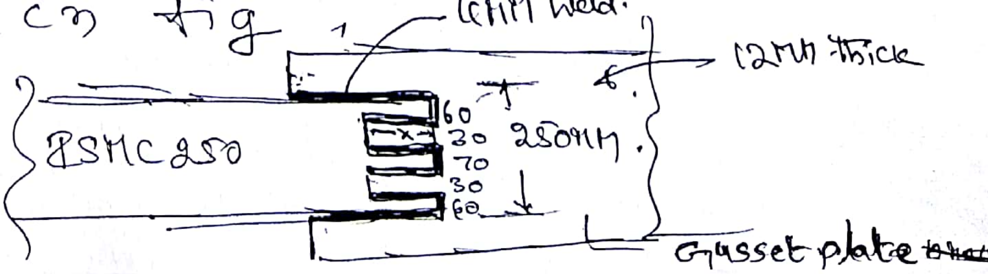
Since allowable length is limited to 400 + 400 mm it needs slot weld. The arrangement can be as shown in the figure with two slots of length 'x'

Then $400 + 400 + (250 - \overset{(2 \times S)}{2 \times 30}) + 4x = 1658$

∴ $x = 167$mm ≃ 170 mm.

as shown in fig

Width of slot = $3t_w$



Q. A Tie member of a truss Consisting of an angle section ISA 70×70×6 mm of Fe 410 grade, is Welded to a 8 mm gusset plate. Design a Weld to transmit a load equal to the full strength of member. Assume shop Welding.

Solution

(1) given angle Section = ISA 70×70×6 mm.

Properties of angle section (Referring steel table)

Area = 806 mm²

$C_{xx} = C_{zz} = 19.4$ mm.

$f_y = 250$ N/mm²

Grade of steel Fe 410 & shop welding ..

$\gamma_{mw} = 1.25$

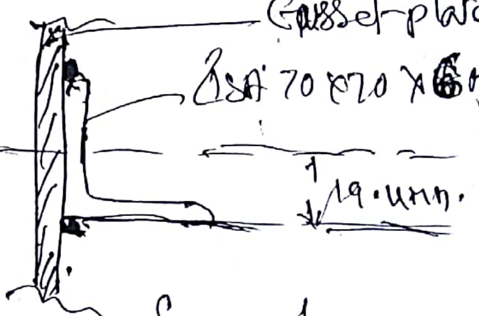
$\gamma_{m0} = 1.10$

Tension strength of the member $= \frac{A_g f_y}{\gamma_{m0}} = \frac{806 \times 250}{1.10}$

$= 183.18 \times 10^3$ N

As C.G of the section is at a distant of 19.4 mm from bottom.

Let L_1 & L_2 be the Weld length at top & bottom



$L_2 \times 19.4 = L_1 \times 50.6$

$L_2 = \frac{50.6}{19.4} \times L_1 \cdot 2.608 L_1$

~~$L_1 + L_2 =$~~

Now design size of Weld $= L_w \times t \times \frac{f_y}{\sqrt{3}} \cdot \frac{1}{\gamma_{mw}}$

Minimum size of Weld = 4 mm > 3 mm.

Maximum size of Weld = 6 mm − 1.5 = 4.5 mm.

∴ provide size of Weld = 4 mm.

Throat thickness = 0.7S = ~~0.7×4 = 2.8~~ mm.

$t = 0.7 \times 4 = 2.8$ mm.

Now design strength of weld $= L_w \times t \times \frac{f_u}{\sqrt{3}} \times \frac{1}{\gamma_{mw}}$

$$= L_w \times 2.8 \times \frac{410}{\sqrt{3}} \times \frac{1}{1.25}$$

Strength of weld should be equal to capacity of tension member

$$183.18 \times 10^3 = L_w \times 2.8 \times \frac{410}{\sqrt{3}} \times \frac{1}{1.25}$$

$L_w = 386.92 mm \simeq 390 MM$.

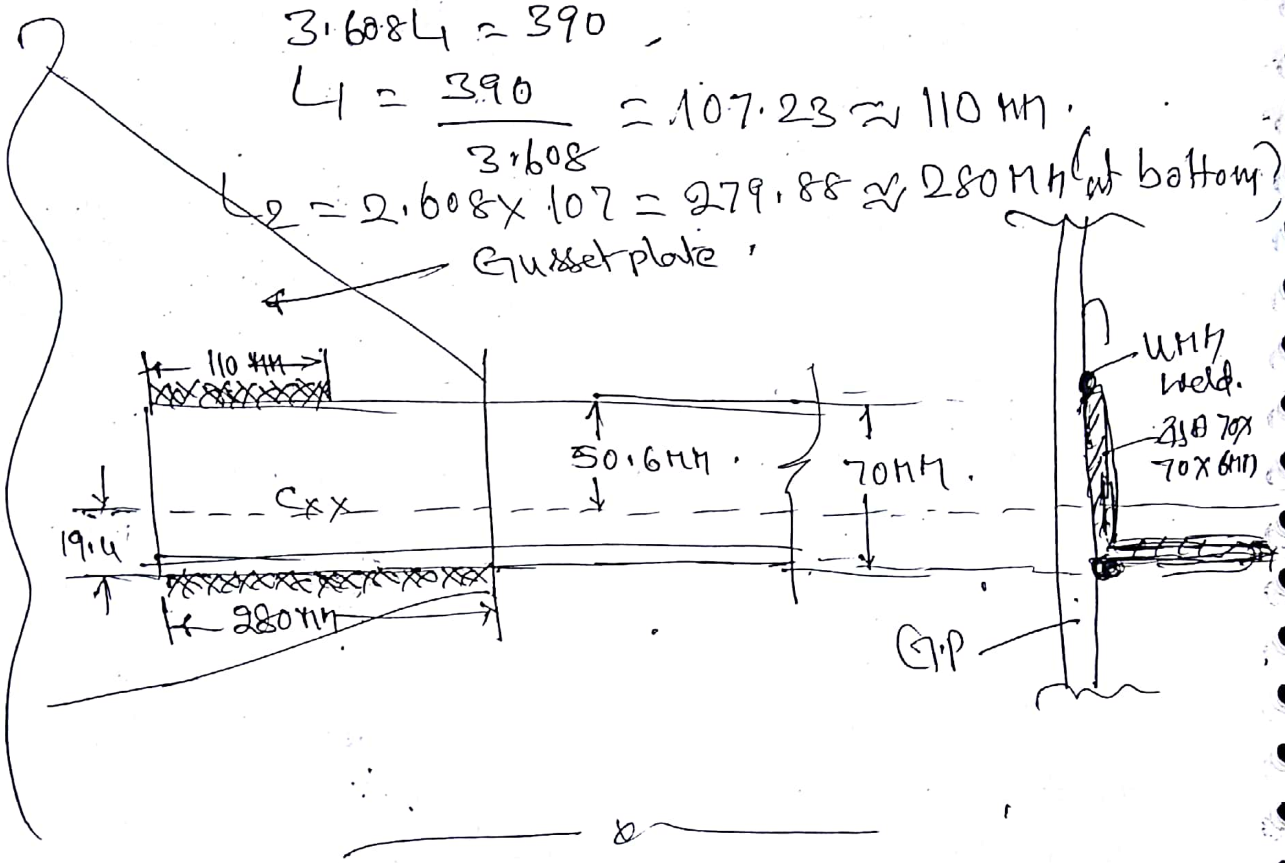
$L_1 + L_2 = 390$

$L_1 + 2.608 L_1 = 390$

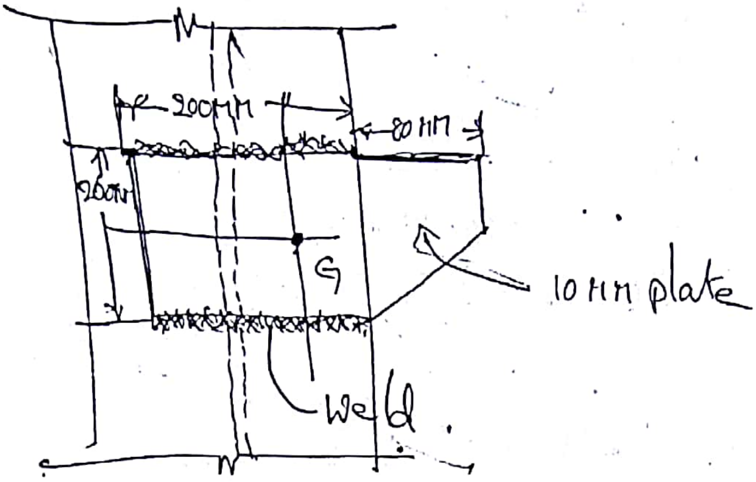
$3.608 L_1 = 390$

$L_1 = \frac{390}{3.608} = 107.23 \simeq 110 MM$.

$L_2 = 2.608 \times 107 = 279.88 \simeq 280 MM$ (at bottom)



Q A Bracket plate is welded to the flanges of a column section ISHB 300 @ 577 N/m as shown in fig. If width of weld is 200 mm depth 260 mm and ~~common~~ eccentricity from the face of column is 80 mm. Determine the size of the weld to support a factored load of 165 KN.

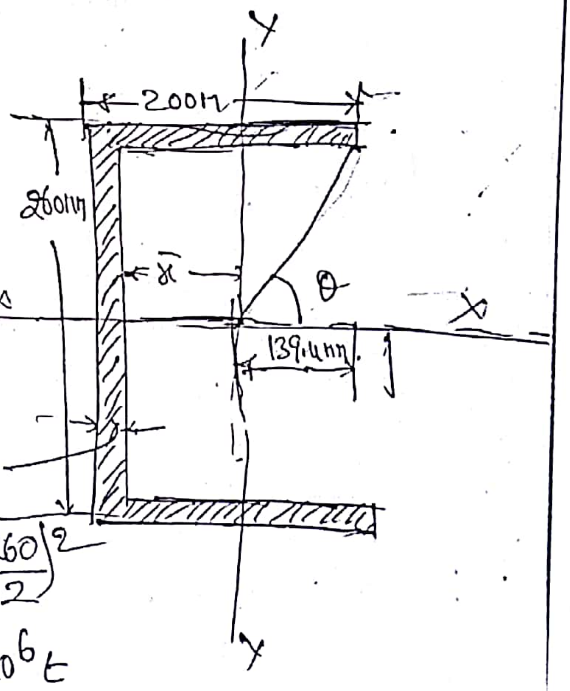


Solution

Data of column section ISHB 300 (from steel table)

Factored load = 165 KN

(1) Size of the weld (t_w)



Area of weld $= 2\times200\times S + 260\times S$

Area of the weld $= 660\,S$

$$\bar{x} = \frac{A_1 x_1}{A} = \frac{2\times200\times\frac{200}{2}\times S}{660\,S}$$

$\bar{x} = 60.60$ mm.

$$I_{xx} = \frac{t\times260^3}{12} + 2\times200\times t\times\left(\frac{260}{2}\right)^2$$

$$= 1.464\times10^6\times t + 6.76\times10^6\,t$$

$$I_{xx} = 8.224\times10^6\,t$$

$$I_{yy} = (260\times t)\times(60.60)^2 + 2\left(\frac{t\times200^3}{12} + 200t\times(100-60.60)^2\right)$$

$$= 9.54\times10^5\,t + 1.34\times10^6\,t + 6.20\times10^5\,t$$

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$I_{YY} = 2.914 \times 10^6 t$

$\therefore$ Polar moment of Inertia $= I_{ZZ} = I_{XX} + I_{YY}$

$I_{ZZ} = 8.224 \times 10^6 t + 2.914 \times 10^6 t$

$I_{ZZ} = 11.13 \times 10^6 t$

To find the distance of extreme point of the weld from C.G. i.e r_{max}

$r_{max} = \sqrt{139.4^2 + 130^2}$

$= 190.61$ mm

$\tan\theta = \frac{130}{139.4} = 0.932$

$\theta = \tan^{-1}(0.932) = 43^\circ$

Hence total eccentricity of load from c.g of the weld $= e' = 80 + 139.4 = 219.4$ mm.

Direct stress $q_1 = \frac{P}{A} = \frac{P}{(2b+d)t} = \frac{165 \times 10^3}{(2 \times 200 + 260)t}$

$q_1 = \frac{250}{t}$ N/mm²

Max shear stress due to twisting moment

$q_2 = \frac{P \cdot e' \times r_{max}}{I_{ZZ}}$

$= \frac{165 \times 10^3 \times 219.4 \times 190.64}{11.13 \times 10^6 t}$

$q_2 = \frac{620.06}{t}$ N/mm²

$\therefore$ Resultant shear stress $= q = \sqrt{q_1^2 + q_2^2 + 2 q_1 q_2 \cos\theta}$

$= \sqrt{\left(\frac{250}{t}\right)^2 + \left(\frac{620.06}{t}\right)^2 + 2 \times \frac{250}{t} \times \frac{620.06}{t} \times \cos 43^\circ}$

$= q = \frac{820.80}{t}$ N/mm²

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Design strength of weld $f_{wd} = \frac{f_u}{\sqrt{3}\,\gamma_{mw}} = \frac{410}{\sqrt{3} \times 1.25} = 189.37\, N/mm^2$

equating max shear of weld with strength of weld.

$$\frac{820.80}{t} = 189.37$$

$t = 4.334$ mm (throat thickness)

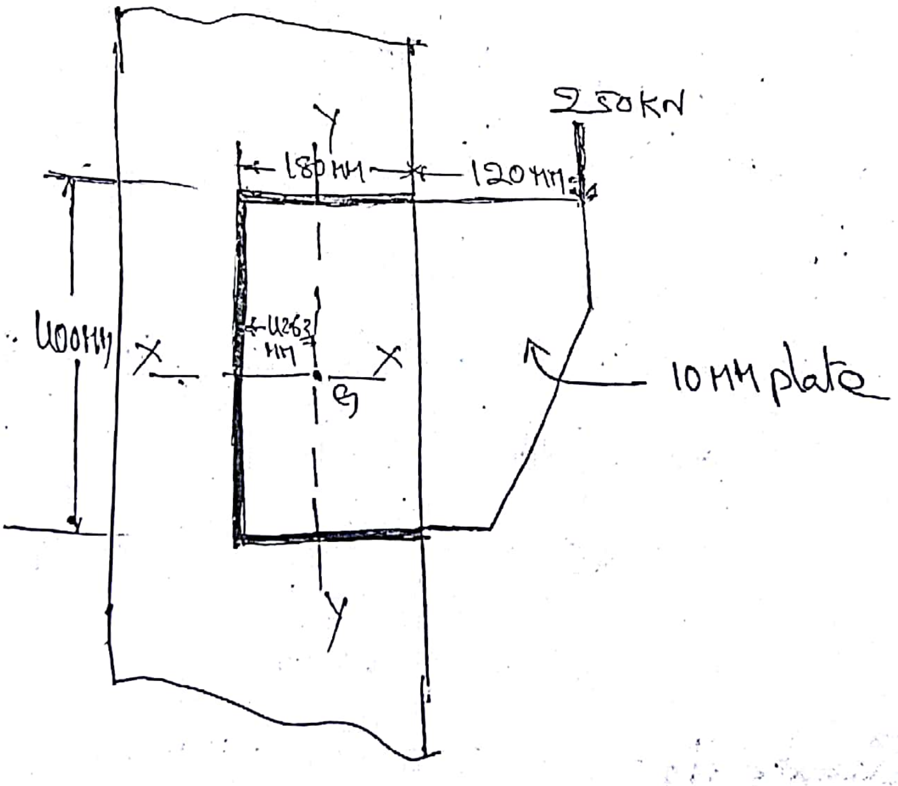
Size of normal fillet weld $= t = 0.7S$

$$S = \frac{t}{0.7} = \frac{4.34}{0.7} = 6.19\,MM \approx 7\,MM$$

∴ Provide size of weld = 7 mm

~~Combined axial & shear stress~~

Q. The 10 mm thick bracket plate shown in fig is connected with the flange of column ISHB 300 @ 577 N/m. Find the size of the weld to transmit a factored load of 250 KN.



Let 't' be the throat thickness of the weld required and $\bar{x}$ be the distance of c.g of weld from vertical weld. Then..

~~Sized~~ Area of weld = A_w.

$$A_w = 400 \times t + (2 \times 180t)$$
$$= 760t$$

$$\bar{x} = \frac{2 \times 180t \times 90}{760t}$$

$$\bar{x} = 42.63 mm.$$

$$I_{xx} = \frac{bd^3}{12} + ah^2$$

$$= \frac{t \times 400^3}{12} + 2 \times 180t \times 200^2$$

$$= 19733333t \ mm^4$$

$$I_{yy} = 400t \times 42.63^2 + 2\left[\frac{t \times 180^3}{12} + 180t(90 - 42.63)^2\right]$$

$$= 2506737t \ mm^4$$

$$\therefore I_{zz} = I_{xx} + I_{yy}$$

$$I_{zz} = 22240070t \ mm^4$$

Distance of extreme point of the weld from centre of gravity

$$= r_{max} = \sqrt{200^2 + (180 - 42.63)^2} = 242.63mm.$$

$$\tan\theta = \frac{200}{180 - 42.63} = 1.4559$$

$$\theta = 55.517^\circ$$

Eccentricity $= e = 120 + 180 - 42.63 = 257.37mm$

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$\therefore$ Direct shear stress $= q_1 = \frac{250 \times 10^3}{760t} = \frac{328.95}{t}$ N/mm²

Maximum Shear stress due to twisting moment $= q_2$

$q_2 = \frac{P \times e \times r_{max}}{I}$ $\left(\frac{M}{I} = \frac{f}{y} = \frac{E}{R}\right)$

$q_2 = \frac{701.950}{t}$ N/mm² $\left(f = \frac{M}{I} \times y\right)$

$\therefore q = \sqrt{q_1^2 + q_2^2 + 2 q_1 q_2 \cos\theta}$

$= \sqrt{\left(\frac{328}{t}\right)^2 + \left(\frac{701.950}{t}\right)^2 + 2 \times \frac{328.95}{t} \times \frac{701.95}{t} \times \cos 55.51}$

$= \frac{928.656}{t}$

Resistance of the weld $= \frac{f_u}{\sqrt{3}} \cdot \frac{1}{1.25} = \frac{410}{\sqrt{3}} \cdot \frac{1}{1.25}$

$= 189.37$ N/mm²

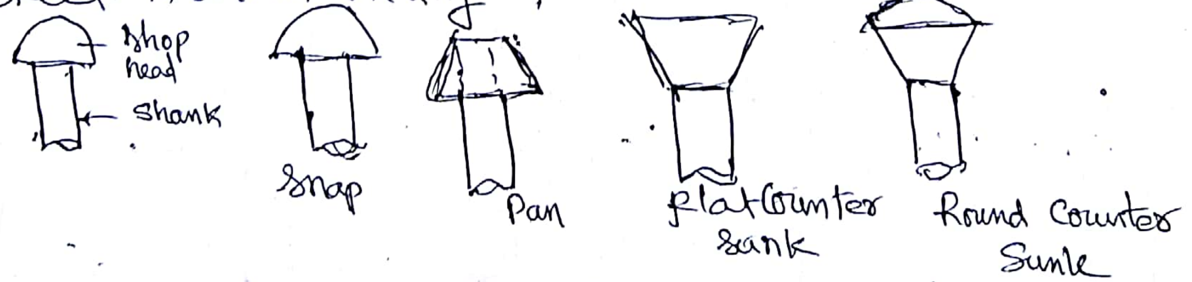
equating maximum shear to it weld $= \frac{928.656}{t} = 189.37$

$\therefore t = 4.904$ mm.

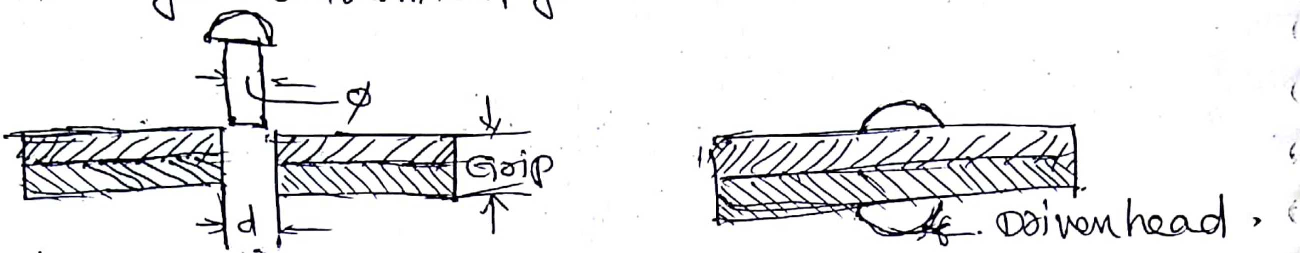
$\therefore$ Size of normal fillet $= \frac{4.904}{0.7} = 7.005$ mm.

$\therefore$ Provide 8mm fillet weld;

Rivited Connections: — A Rivit is made of round ductile steel bar piece known as shank and with a head at the one end. It is made of mild steel or high tensile steel. As shown in fig.



Riviting :- Riviting is method of jointing together pieces of Metal by inserting a ductile metal pins known as **Rivit** into the holes of the pieces to be connected and forming a head at the end of the rivit to prevent each metal piece from coming out as shown in fig.



Where d is the gross diameter of the rivit and φ is nominal diameter of the rivit, (d − φ) is the initial clearance.

⇒ The shank is made of the length to the extend through the parts to be connected and with sufficient extra length for a second head to be made at the other end.

⇒ Grip = distance between the undersides of the two heads, as shown in above fig.

⇒ The grip length should not be more than 4d.

⇒ The driven head can be formed by hand hammering (when the rivet bar is hot) (or) hydralic pressure driving.

⇒ Hot driven rivets :- Rivets are driven in hot condition.

⇒ Shop rivets :- Rivits are placed in workshop.

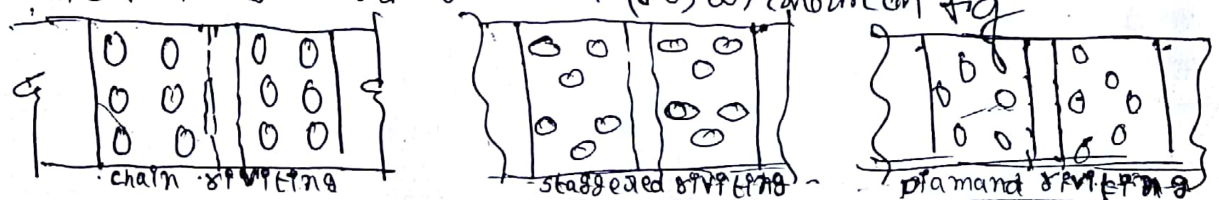
⇒ Field rivets :- Rivets are placed in field / site.

⇒ The use of cold driven is limited as high pressure is required to form the head at room temparature.

Clamping Action :- When the hot driven rivits are cooled down, it's diameter and sunk length reduces. The reduction of sunk length causes compression in the plates and it results in friction between the plates and is called clamping action.

Patterns of Rivited joints :-

The rivits may be placed in variety of patterns depending on the space avilable and the shape of the members to be connected. The most common types as shown in fig.



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