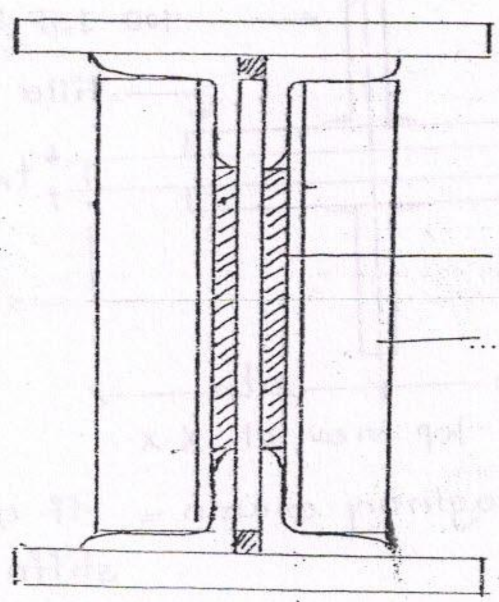
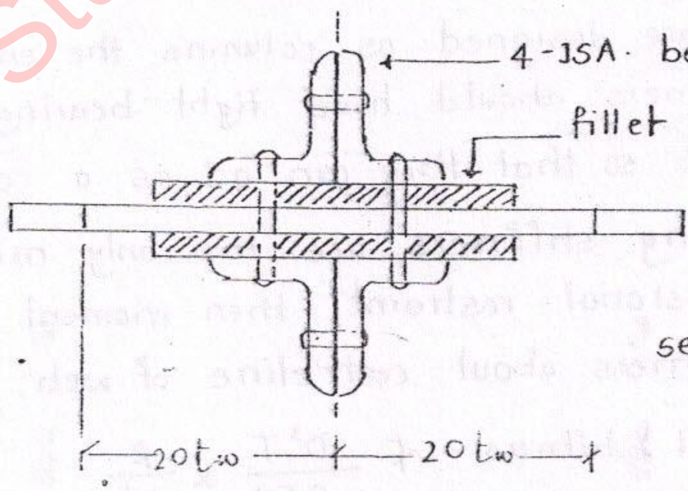
Design of end bearing stiffner :



(i) They are designed as imaginary columns with both ends are fixed whose effective length is, $L = 0.7\ L_1$ where L_1 is length of bearing stiffners between flange angles as shown in fig.

(ii) The c/s area of the imaginary column is taken as the c/s area of the angles and the web area whose length is $40\ t_w$ as shown in fig.



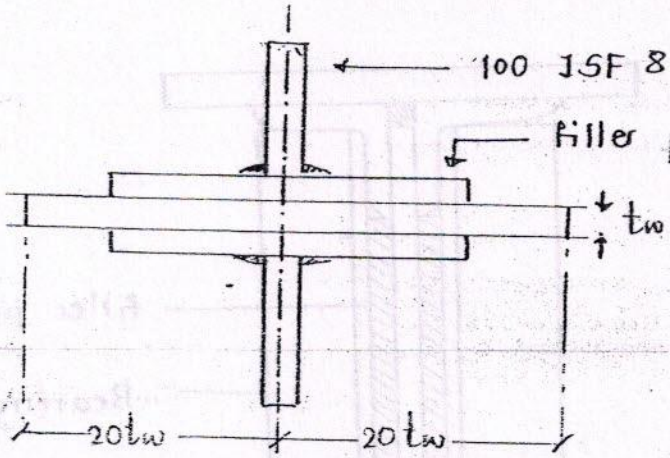
Eff. c/s area of imaginary column = web area x + 4 angles area

$$A_g = (40t_w \times t_w) + \text{Angles area}$$

Web area.

Note:

If flats are used as bearing stiffners.



Top view at X-X

Eff. c/s area of imaginary column = eff. c/s area of bearing stiffner.

= web area + 2× flat area.

$$A_g = (40\,t_w)\cdot t_w + (2\times \text{flat area})$$

(iii) Since bearing stiffners are designed as columns, they should be vertical and should not be joggled (i.e. they should not be bent to touch the web plate) and the gap between bearing stiffners and web plates must be filled by filler plate.

(iv) Since they are designed as columns, the ends of the bearing stiffners should have tight bearing between the flange angles so that they can act as a column.

(v) If the bearing stiffners are the only means of providing torsional restraint, then moment of inertia of bearing stiffners about centreline of web,

$$(M.I.)_{stiffners} \nless \frac{D^3 T}{250} \times \frac{R}{W}$$

where.

D - overall depth of plate girder

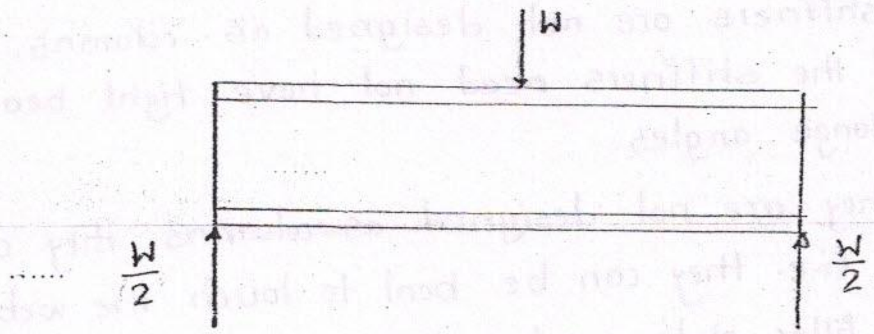
T - max. thickness of compression flange

R - bearing reaction / support reaction.

W - total load on girder.

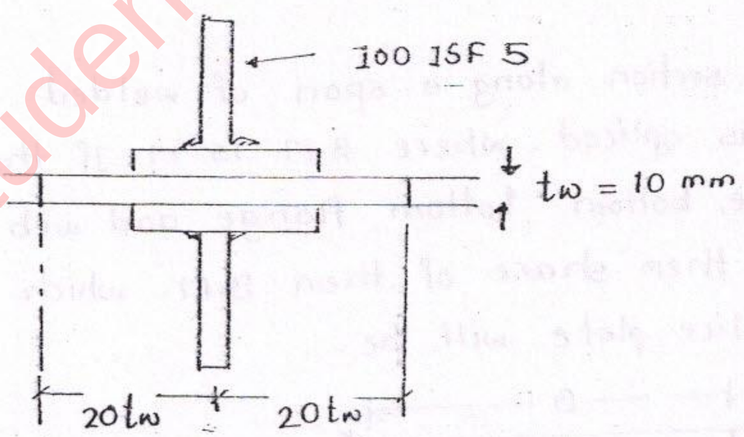
Note :

(i) For simply supported plate girder, $R = \frac{W}{2}$



(ii) The other means of providing torsional restraint are, web cleat, flange cleat and extending plate girder into wall.

Q. At a certain location of a plate girder of web size 1000×10 mm, a pair of bearing stiffners, 100×5 mm is welded. The effective area of bearing stiffner is —.



$= 40 \times 10$

$= 400$

Effective area = web area + 2 (flat area)

$= (40\, t_w)\, t_w + 2\,(100 \times 5)$

$= (40 \times 10) \times 10 + 1000$

$= 5000 \text{ mm}^2$

Design of vertical stiffners :

(i) They are used to prevent web buckling due to digonal compression (developed due to shear force.)

(ii) These stiffners are not designed as columns, So the ends of the stiffners need not have tight bearing with flange angles.

(iii) Since they are not designed as columns, they can be joggled. (i.e. they can be bent to touch the web plate so that filler plate need not be provided)

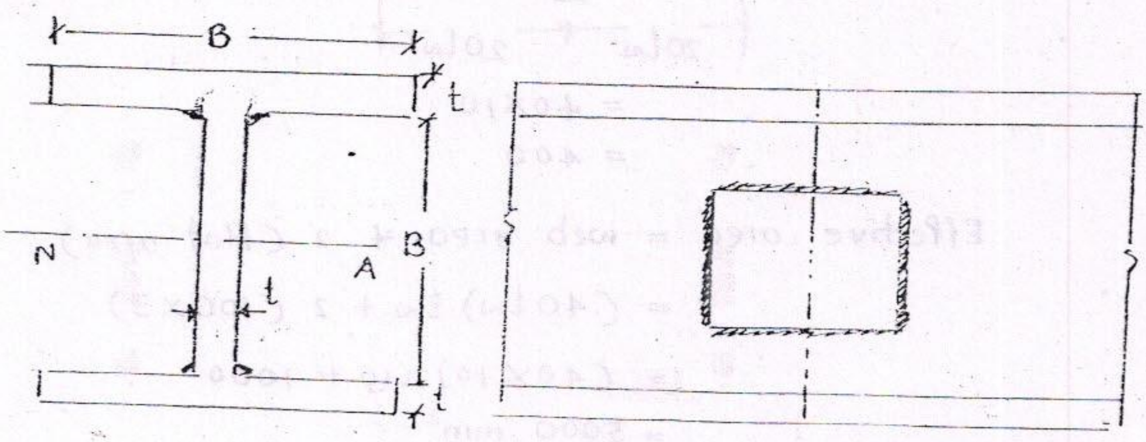
(iv) Minimum spacing of stiffners $= 0.33\ d_1$

Maximum spacing of stiffners $= 1.5\ d_1$

d_1 - clear depth of web.

As the spacing of vertical stiffners increase, buckling possibility of web between stiffners increase. So the maximum permissible shear stress in web decreases as the spacing of stiffners increases.

Q. At a section along a span of welded plate girder the web is spliced. where B.M is M. If the girder has top flange, bottom bottom flange and web plates of equal area. then share of them B.M. which will be taken up by splice plate will be...



Treat flanges as line areas. $(t^3 \approx 0)$

Moment taken by splice plate = Moment taken by web (M_w)

$$\frac{M_w}{I_w} = \frac{M}{I}$$

$$M_{web} = \frac{M}{I} \times I_{web}$$

I - M.I. of entire section.

$$= \left[\frac{B \cdot t^3}{12} + (Bt)\cdot\left(\frac{B}{2}\right)^2\right] \times 2 + \left[\frac{tB^3}{12}\right]$$

($t^3 \approx 0$; 2 flanges; web)

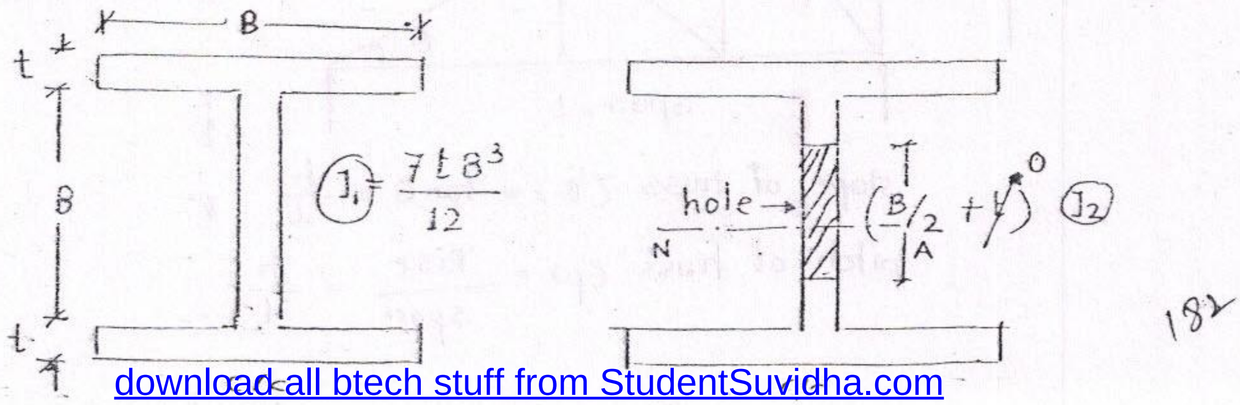
$$= \frac{B^3 t}{2} + \frac{tB^3}{12} = \frac{7tB^3}{12}$$

$\therefore$ I_w - M.I. of web alone $= \frac{tB^3}{12}$

$\therefore$ $M_w = M \times \frac{tB^3/12}{7tB^3/12}$

$= \frac{M}{7}$ = Moment taken by splice plate.

Q. A symmetrical plate girder has been fabricated with 3-equal plates. If a circular hole of diameter equal to half of its height is centrally cut in the web what is the approximate ratio of the strength of punctured plate girder to that of original plate girder.



$$J_2 = \frac{7tB^3}{12} - \frac{t(B/2)^3}{12} \quad \left(\text{not } \frac{\pi D^4}{64}\right)$$

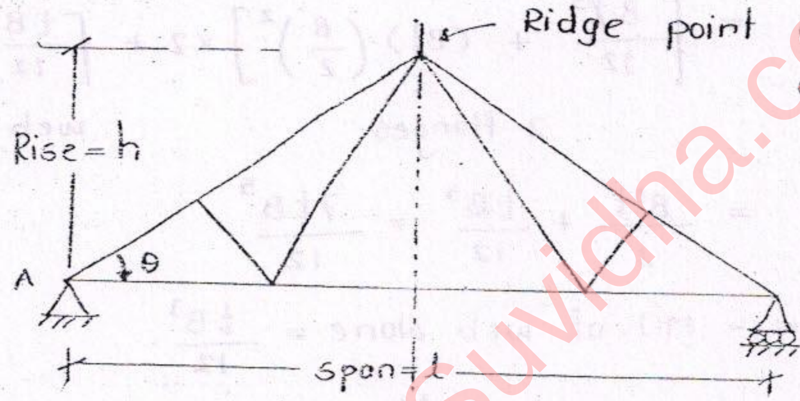
Solid C/S (M.I. of circular hole + projected area)

$$= \frac{55\,t\,B^3}{96}$$

$$\text{Loss of strength} = \frac{J_2}{J_1} = \frac{(55\,tB^3/96)}{(7tB^3/12)} = 0.98 \rightarrow 98\%.$$

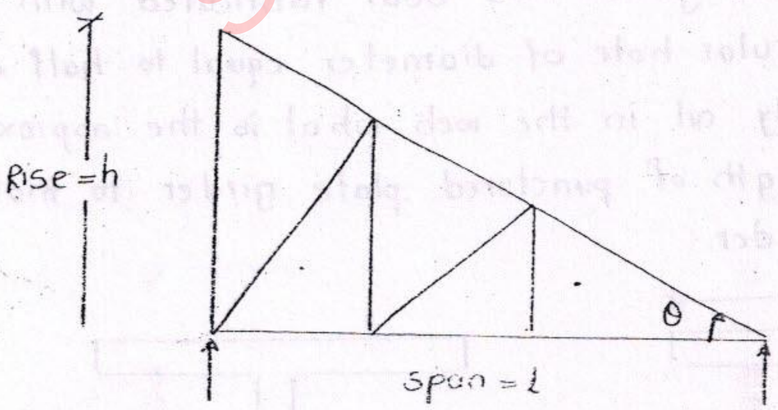
Design of Industrial roof trusses:

(i)



$$\text{Slope of truss } (\theta) = \tan\theta = \frac{h}{l/2} = \frac{\text{Rise}}{\text{half of span}}$$

$$\text{Pitch of truss } (p) = \frac{\text{Rise}}{\text{Span}} = \frac{h}{l}$$



North light roof truss.

$$\text{slope of truss } (\theta) = \tan\theta = \frac{h}{l}$$

$$\text{pitch of truss } (p) = \frac{\text{Rise}}{\text{Span}} = \frac{h}{l}$$