Design of Diagonal Member

Bolt strength = 30 kN

no. of bolt required $= \frac{31.2}{30} = 1.04 = 2$

$\alpha = 0.6$

$T_{dn} = \alpha \frac{A_n f_u}{\gamma_{m1}}$

$A_n = 139.5$ mm

from steel table

ISA 60x40x8 mm

$A_g = 736.86$ mm^2

Assuming diameter of bolt (d) = 16mm

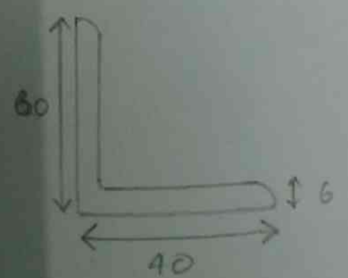
Grade of bolt = 4.6

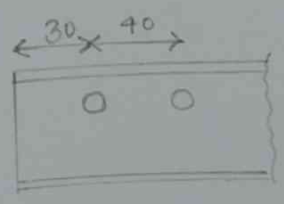
① $T_{dg} = A_g \times \frac{f_u}{\gamma_{mo}}$

$T_{dg} = \frac{250}{1.10} \times 736.86 = 167$ kN

(ISA 60x40x6
564.86 mm) $\frac{250}{1.10} \times 564.86 = 128.37$ kN

Net section





$W = 40\,mm \quad b_s = 40+20-5 = 55\,mm$
$t = 6\,mm \quad L_c = 40\,mm$

$$\beta = 1.4 - 0.076 \times \left(\frac{40}{6}\right)\left(\frac{250}{410}\right)\left(\frac{55}{40}\right)$$

$$= 0.972 \leq 1.443$$
$$\geq 0.7$$

$$A_{nc} = \left(60 - \frac{6}{2} - 18\right) \times 6 = 234\,mm^2$$
$$A_{go} = \left(40 - 6/2\right) \times 6 = 222\,mm^2$$

$$T_{dn} = 0.9\,A_{nc}\,\frac{f_u}{\gamma_m} + \phi\,\beta\,\frac{A_{go} f_y}{\gamma_{mo}}$$

$$= 0.9 \times 234 \times \frac{410}{1.25} + 0.972 \times (222) \times \frac{250}{1.10}$$

$$T_{dn} = 118\,kN > 31.2\,kN$$

Check in compression

Length of member, $l = 5.20\,mm$
$\gamma_{vv} = 8.5\,mm$

2 bolt (Assume)

$k_1 = 0.20, \; k_2 = 0.35, \; k_3 = 20$

for ISA $60 \times 40 \times 6$

$B_1 = 60 \quad t = 6m$

$B_2 = 40$

$$\lambda_{vv} = \frac{l/\gamma_{vv}}{\varepsilon\sqrt{\frac{\pi^2 E}{250}}} = \frac{\frac{5200}{8.5}}{\sqrt{\frac{\pi^2 \times 2 \times 10^5}{250}}}$$

$$= 6.88$$

$$\lambda_\phi = \frac{b_1+b_2}{2t\,\varepsilon\sqrt{\frac{\pi^2 E}{250}}} = \frac{(60+40)}{2\times 6\sqrt{\frac{\pi^2\times 2\times 10^5}{250}}}$$

$$= 0.093$$

$$\lambda_e = \sqrt{k_1^2 + k_2\,\pi_{vv}^2 + k_3\,\lambda_\phi^2}$$

$$\lambda_e = \sqrt{0.20 + 0.35\times 6.88^2 + 20\times 0.093^2}$$

$$\lambda_e = 4.115$$

for angle section $\Rightarrow$ buckling class c

$\therefore \alpha = 0.49$

$$\phi = 0.5\left[1+\alpha(\lambda_e - 0.2) + \lambda_e^2\right]$$

$$\phi = 0.5\left[1+0.49\,(4.115-0.2) + 4.115^2\right]$$

$$\phi = 9.92$$

$$\chi = \frac{1}{\phi+\sqrt{\phi^2-\pi_e^2}} = \frac{1}{9.92+\sqrt{9.92^2-4.115^2}} \leq 1.0$$

$$\chi = 0.05 < 1.0 \quad (\text{OK})$$

$$f_{cd} = 0.05\times\frac{250}{1.10}$$

$$f_{cd} = 11.36 \text{ MPa}$$

$\therefore$ Design Compressive strength

$$P_{cd} = f_{cd}\times A_g$$

$$\therefore P_{cd} = 11.36\times 736.86$$

$$\therefore P_{cd} = 8.37 \text{ kN} > 8.318 \text{ kN} \quad (\text{OK})$$

$\therefore$ Also safe in Compression

Design of critical purlin

from Analysis,

$$M_{uz} = 38.561 \text{ kNm}$$

$$M_{uy} = 0$$

$$\therefore Z_{pz,req} = \frac{M_{uz}}{f_y/\gamma_{mo}} + \left(2.5\frac{d}{b}\right)\frac{M_{uy}}{f_y/\gamma_{mo}}$$

$$\therefore Z_{pz,req} = \frac{38.561 \times 10^6}{250/1.10} + 0$$

$$\therefore Z_{pz,req} = 169668.4 \text{ mm}^3$$

Lets try ISMC 200 @ 217 N/m,

from steel table,

$A_g = 2821.3 \text{ mm}^2$	$I_{zz} = 1819.3 \times 10^4 \text{ mm}^4$
$h = 200 \text{ mm}$	$I_{yy} = 140.4 \times 10^4 \text{ mm}^4$
$b_f = 75 \text{ mm}$	$Z_{pz} = 211254.07 \text{ mm}^3$
$t_f = 11.4 \text{ mm}$	$Z_{py} = 50724.65 \text{ mm}^3$
$t_w = 6.1 \text{ mm}$	$R = 11 \text{ mm}$

$$\therefore d = 200 - 2 \times 11.4 - 2 \times 11 = 155.2 \text{ mm}$$

$$\therefore Z_{ez} = \frac{I_{zz}}{h/2} = \frac{1819.3 \times 10^4}{200/2} = 181930 \text{ mm}^3$$

$$\therefore Z_{ey} = \frac{I_{yy}}{b_f/2} = \frac{140.4 \times 10^4}{75/2} = 37440 \text{ mm}^3$$

- Section classification (Table 2),

$\frac{b}{t_f} = \frac{75/2}{11.4} = 3.289 < 9.4\epsilon$ $(\because \epsilon = 1)$

$\frac{d}{t_w} = \frac{155.2}{6.1} = 25.44 < 84\epsilon$ $(\because \epsilon = 1)$

$\therefore$ The cohoosen section is a plastic section.

i.e $\beta_b = 1.0$

- Check for bending,

$\therefore M_{dz} = \beta_b Z_{pz} \frac{f_y}{\gamma_{m_0}} \nleq 1.2 Z_{ez} \frac{f_y}{\gamma_{m_0}}$

$\therefore M_{dz} = 1.0 \times 211254.07 \times \frac{250}{1.10} \nleq 1.2 \times 181930 \times \frac{250}{1.10}$

$\therefore M_{dz} = 48.0$ kNm $\nleq 49.6$ kNm (OK)

$\therefore \boxed{M_{dz} = 48.0 \text{ kNm}} > M_{uz}$ (OK)

$\therefore M_{dy} = \beta_b Z_{py} \frac{f_y}{\gamma_{m_0}} \nleq 1.2 Z_{ey} \frac{f_y}{\gamma_{m_0}}$

$\therefore M_{dy} = 1.0 \times 50724.65 \times \frac{250}{1.10} \nleq 1.2 \times 37490 \times \frac{250}{1.10}$

$\therefore M_{dy} = 11.5$ kNm $\nleq 10.2$ kNm (not ok)

Adopt, $\boxed{M_{dy} = 10.2 \text{ kNm}} > M_{uy}$ (OK)

Hence, The Purlin is safe about both major and minor axis.

Design of beam

From the analysis in SAP model, we get

Max^m B.M = 27.287 kN-m , Length = 15 m

shear force = -32.494 kN

on.

~~for~~ since it is laterally unsupported,

M = 27.287 kN

$M = \beta_b Z_p f_y / \gamma_{mo}$

$Z_p = \frac{1.25 \times M \times 1.1}{250} = 120062.8 \times 1.25$

$= 150078.5 \ mm^3$

250

1.10

From steel table, Take ISLB 400

$Z_{pz} = 1099450 \ mm^3$ $\quad r_x = 16.33 \ cm$

$Z_{ez} = 965.3 \ cm^3$ $\quad r_{yy} = 3.15 \ cm$

$h = 400 \ mm$ $\quad I_x = 19306.3 \ cm^4$

$b_f = 165 \ mm$ $\quad I_y = 716.4 \ cm^4$

$t_f = 12.5 \ mm$ $\quad r_1 = 16 \ mm$

$t_w = 8 \ mm$

Clause 8.2.21

$$M_{cr} = \frac{\pi^2 E I_y h_f}{2 L_{LT}^2} \left[1 + \frac{1}{20} \left(\frac{L_{LT}/r_y}{h_f/t_f} \right)^2 \right]^{0.5}$$

$$M_{cr} = \frac{\pi^2 \times 2 \times 10^5 \times 716.4 \times 10^4 \times (400-12.5)}{2 \times 15000^2} \left[1 + \frac{1}{20} \left(\frac{\left(\frac{15000}{31.5}\right)^2}{\frac{(400-12.5)}{12.5}} \right)^2 \right]^{0.5}$$

$= 3.5774 \times 12177117.91$

$= 43562760.87$

$\lambda_{LT} = \sqrt{}$ 10

<u>Clause 8.2.2</u>

$$\lambda_{LT} = \sqrt{\beta_p Z_p f_y / M_{cr}}$$

<u>Clause 3.7.2 & 3.7.4</u>

$$b/t_f = \frac{b_f/2}{t_f} = \frac{165/2}{12.5} = 6.6 < 9.4\epsilon$$

$$d/t_w = \frac{400 - 2(12.5 + 16)}{8} = 42.875 < 84\epsilon$$

Therefore it is plastic section

so $\beta_p = 1$

$$\lambda_{LT} = \sqrt{\frac{1 \times 1094450 \times 250}{43562760.87}} = 2.511$$

$$\phi_{LT} = 0.5\left[1 + \alpha_{LT}(\lambda_{LT} - 0.2) + \lambda_{LT}^2\right]$$

for rolled steel section $\alpha_{LT} = 0.21$

$$\phi_{LT} = 0.5\left[1 + 0.21(2.511 - 0.2) + 2.511^2\right]$$

$= 3.895$

$\chi_{LT} =$ ~~$0.5\left[1 + \alpha_{LT}(\lambda_{LT} - 0.2) +\right.$~~

$$\chi_{LT} = \frac{1}{\phi_{LT} + [\phi_{LT}^2 - \lambda_{LT}^2]^{0.5}}$$

$$\chi_{LT} = \frac{1}{3.895 + (3.895^2 - 2.511^2)^{0.5}}$$

$$\chi_{LT} = 1/6.873 = 0.1454 \leq 1 \quad (o.k)$$

$$f_{bd} = \frac{0.145 \times 250}{1.1} = 32.95$$

$$\lambda_{LT} \leq \sqrt{1.2\, Z_e f_y / M_{cr}}$$

$$\leq \sqrt{1.2 \times 965300 \times 250 / 43562760.87}$$

$$\lambda_{LT} \leq 2.57 \rightarrow (o.k)$$

$$M_d = \beta_b Z_p f_{bd}$$

$$= 1 \times 1099450 \times 32.95$$

$$= 36.2268 \text{ kN-m} > M (27.287)$$

$\therefore$ It is safe

<u>check for shear</u>

(clause 8.4)

$$V_d = \frac{d\, t_w\, f_{yw}}{\sqrt{3}\, \gamma_{m0}}$$

$$= \frac{\{400 - 2(12.5 + 16)\} \times 8 \times 250}{\sqrt{3} \times 1.1}$$

$$= 360.056 \text{ kN} > (32.454)$$

$\therefore$ safe in shear

Design of Vertical Chord:

Top view:

Maximum Axial force = 12.476 kN

Load condition : 1.5 (DL + WL)

Designing:

Assuming the dia of bolt (d) = 16mm

Grade of bolt = 4.6

and Assume, shear strength of bolt = 30kN

no. of bolt required $\simeq \frac{12.476}{30} = 0.415 \simeq 1$

providing 2 bolts

$\alpha = 0.6$

Area Required from Gross section yielding (claus 6.2)

$$T_{dg} = A_g \frac{\alpha \cdot f_y}{\gamma_{m0}}$$

$$A_{g\,req} = \frac{12.476 \times 10^3 \times 1.1}{250}$$

$$= 54.89\,mm^2$$

Choosing ISA 50× 30×5 from steel table ($A_{provd} = 377.6\,mm^2$)

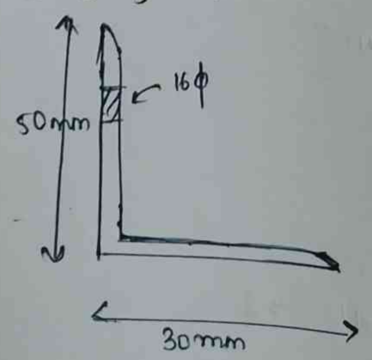
Check on Gross Section yielding:

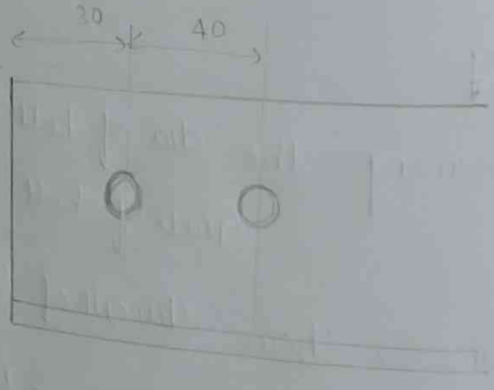
$$T_{dg} = \frac{f_y}{\gamma_{m0}} \times A_{g\,provd}$$

$$= \frac{250}{1.10} \times 377.63$$

$$T_{dg} = 85.8\,kN \quad > T_{applied}\ (12.476\,kN)$$

Check on net Section rupture:





Assuming edge distance 30mm and pitch = 40mm

Clause 6.

$w = 30mm$ $\quad b_s = 30+20-5 = 45mm$

$t = 5mm$ $\quad L_c = 40mm$

$$\beta = 1.4 - 0.076\left(\frac{w}{t}\right)\left(\frac{f_y}{f_u}\right)\left(\frac{b_s}{L_c}\right) \le \frac{f_u}{f_y}\left(\frac{\gamma_{m0}}{\gamma_{m1}}\right)$$

$$= 1.4 - 0.076\left(\frac{30}{5}\right)\left(\frac{250}{410}\right)\left(\frac{45}{40}\right) \le 1.443$$

$$\ge 0.7$$

$$\beta = 1.087 \le 1.443$$

$$\ge 0.7$$

$$A_{nc} = \left(50 - \frac{5}{2} - 18\right) \times 5 = 147.5 mm^2$$

$$A_{go} = \left(30 - 5/2\right) \times 5 = 137.5 mm^2$$

$$T_{dn} = 0.9 A_{nc}\left(\frac{f_u}{\gamma_m}\right) + \beta A_{go}\left(\frac{f_y}{\gamma_{m0}}\right)$$

$$= 0.9 \times 147.5\left(\frac{410}{1.25}\right) + 1.087 \times 137.5 \times \frac{250}{1.1}$$

$$T_{dn} = 77.5 kN$$

$$T_d = \min(T_{dg}, T_{dn})$$

$$T_d = 77.5 kN \quad > 12.476 kN$$

Design Of Bottom Chord

From the analysis in SAP model, we get

$\therefore$ Axial Force = 143.157 kN.

Now,

$\therefore$ Required Area $= \dfrac{1.1 \times 143.157 \times 10^3}{250}$

$= 629.89 \ mm^2$.

For steel table,

Choose section :- 65 x 65 x 8 angle with $A_g = 976 \ mm^2$.
(ISA - 6565).

$\therefore$ Strength of yielding, $T_{dg} = \dfrac{A_g \cdot f_y}{\gamma_{m_0}}$.

$= \dfrac{976 \times 250}{1.1} = 221{,}818 \ kN$
$\simeq 221.82 \ kN$.

$\therefore$ Assume, Diameter of bolt = 20 mm

~~Diatet~~ Diameter of hole = (20 + 2) = 22 mm

$\therefore$ Net area of the connected leg, $A_{nc} = (65 - 4 - 22) \times 8$

$= 312 \ mm^2$.

$\therefore$ Gross area of outstanding ~~leg~~ leg, $A_{go} = (65 - 4) \times 8$

$= 488 \ mm^2$.

$\therefore$ Assume, strength of 1- bolt = 40 kN.

$\therefore$ Required number of bolt $= \dfrac{143.57}{40} = 3.589$

$\simeq 4$.

$\Rightarrow$ Provide :-

Number of bolt = 4.

Pitch = 60 mm

edge distance = 40 mm.

• ~~Strength governed by rupture of critical section~~ :-

$$\therefore T_{du} = \frac{0.9\, f_u \cdot A_{ne}}{\gamma_{m1}} + \frac{\beta\, A_{go} \cdot f_y}{\gamma_{mo}}$$

$$\therefore \beta = 1.4 - 0.076\left(\frac{w}{t}\right)\cdot\left(f_y/f_u\right)\left(\frac{b_s}{L_c}\right) \le \left(\frac{f_u\, \gamma_{mo}}{f_y \cdot \gamma_{m1}}\right)$$
$$\ge 0.7$$

$$= 1.4 - 0.076\left(\frac{65}{8}\right)\cdot\left(\frac{250}{410}\right)\cdot\left(\frac{61+35}{3\times 60}\right) \le \left(\frac{410\times 1.1}{250\times 1.25}\right)$$
$$\ge 0.7$$

$$\therefore \beta = 1.199 \le 1.4432$$
$$\ge 0.7$$

$$\therefore T_{du} = \frac{0.9\times 410\times 312}{1.25} + \frac{1.199\times 488\times 250}{1.1}$$

$$= (92124.4 + 132980.)\ N.$$

$$= 225.104\ kN.$$

Alternatively, $\therefore T_{du} = \dfrac{\alpha A_n f_u}{\gamma_{m1}}$ $\left[\because \text{No. of bolt} \ge 4 \text{ then, } \alpha = 0.8\right]$

$$= \frac{0.8\times(312+488)\times 410}{1.25}$$

$$= 209.92\ kN.$$

• Strength governed by block shear :-

$$\therefore T_{db1} = \left[\frac{A_{vg}\cdot f_y}{\sqrt{3}\cdot\gamma_{mo}} + \frac{0.9\, A_{tn}\, f_u}{\gamma_{m1}}\right].$$

$$\therefore T_{db2} = \left[\frac{0.9\, A_{vn}\, f_u}{\sqrt{3}\cdot\gamma_{m1}} + \frac{A_{tg}\cdot f_y}{\gamma_{mo}}\right].$$

$\therefore A_{vg} = 8 \times [3 \times (60+40)] = \cancel{176}\ 2400\ mm^2$

$\therefore A_{vn} = 8 \times \{3 \times (60+40) - (3.5 \times 22)\} = 1784\ mm^2$

$\therefore A_{tg} = 8 \times 30 = 240\ mm^2$

$\therefore A_{tn} = 8 \times \left(30 - \frac{22}{2}\right) = 152\ mm^2$

$$\therefore T_{db_1} = \left[\frac{2400 \times 250}{\sqrt{3} \times 1.1} + \frac{0.9 \times 152 \times 410}{1.25}\right]$$

$$= 359.78\ kN$$

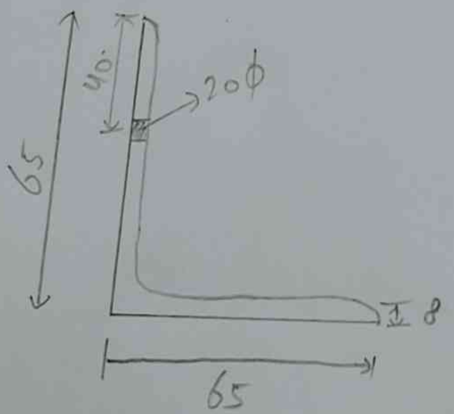
$$\therefore T_{db_2} = \left[\frac{0.9 \times 1784 \times 410}{\sqrt{3} \times 1.25} + \frac{240 \times 250}{1.1}\right]$$

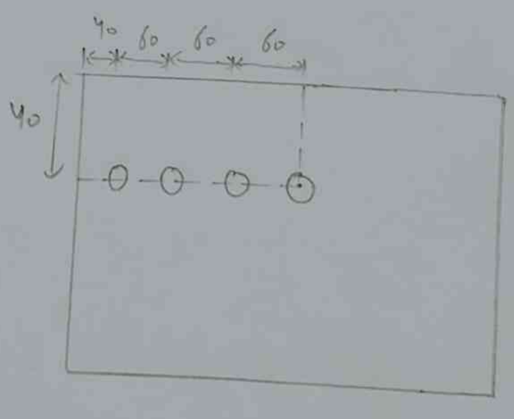
$$= \cancel{501.102}\ 258.83\ kN$$

$\therefore$ Tension capacity of angle; $T_d = \min.\text{ of } \{T_{dg}, T_{dn}, T_{db_1}, T_{db_2}\}$

$= 209.92\ kN > 143.57\ kN$

(O.K.)





(All dimensions are in "mm")

Design of Top Chord

Assume $f_{cd} = 83.7$

$L = 5024$ mm

$P_u = 45.44$ KN

$f_u = 410$ Mpa

$f_y = 250$ Mpa

$E = 2\times10^5$ Mpa

$K = 1$, $\lambda = 120$

for angle section,

Buckling class 'c'

assumed $f_{cd} = 83.7$ Mpa

$$A_{req} = \frac{P_u}{f_{cd,assume}} = \frac{45.44\times1000}{83.7} = 542.891\ mm^2$$

from steel table

choosing, section ISA 125 x 75 x 10

$A_g = 1901.93\ mm^2$

$r_v = 16.1$ mm

from table . 12 value of K_1, K_2, K_3 for 2 bolts are

$K_1 = 0.2$, $K_2 = 0.35$, $K_3 = 20$

from 7.5.1.2

$$\lambda_{vv} = \frac{\left(\frac{L}{r_{vv}}\right)}{\varepsilon\sqrt{\frac{\pi^2E}{250}}} = \frac{\frac{5025}{16.1}}{(1)\sqrt{\frac{\pi^2\times2\times10^5}{250}}}$$

$\varepsilon = 1$

$= 3.513$

$$\lambda_0 = \frac{\frac{(125+75)}{2\times 10}}{88.812} \qquad \left(\lambda_0 = \frac{(b_1+b_2)/2t}{E\sqrt{\frac{\pi^2 \times E}{250}}}\right)$$

$$= 0.112$$

$$\lambda_e = \sqrt{k_1 + k_2 \lambda_{vv}^2 + k_3 \times \phi^2}$$

$$= \sqrt{0.2 + 0.35(3.53)^2 + 20(0.112)^2}$$

$$\lambda_e = \sqrt{4.770} = 2.184$$

$$\lambda_e = 2.184$$

for buckling class $\alpha = 0.49$ (clauses 7.1.1 & 7.1.2.1)

from 7.1.2.1

$$\phi = 0.5\left[1 + \alpha(\lambda - 0.2) + \lambda^2\right]$$

$$= 0.5\left[1 + 0.49(2.184 - 0.2) + 2.184^2\right]$$

$$\phi = 3.371$$

$$\chi = \frac{1}{\left[\phi + (\phi^2 - \lambda^2)^{0.5}\right]}$$

$$\chi = \frac{1}{\left[3.37 + \sqrt{3.371^2 - 2.184^2}\right]} = \frac{1}{5.937} = 0.168$$

$$f_{cd} = \chi\left(\frac{250}{1.1}\right) \Leftrightarrow \chi\left(\frac{f_{cd}}{\gamma_{m0}}\right)$$

$$= 0.168\left(\frac{250}{1.1}\right) = 38.181$$

$$P_{cd} = f_{cd} \times A_g$$

$P_{cd} = 38.181 \times 1901.93$

$= 72.619$ KN

$45.44 < 72.619$ (Hence safe) (compression)

Selected section is $125 \times 75 \times 10$

Check for tension.

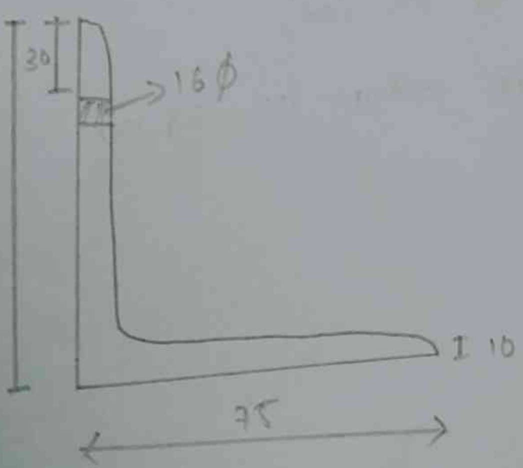
Gross section yielding (clause 6.2)

$$T_{dg} = \frac{f_y}{\gamma_{m0}} \cdot A_g$$

$$T_{dg} = \frac{250}{1.1} \times 1901.93$$

$$T_{dg} = 432.26 \text{ KN}$$

Net section rupture (clause 6.3.3)



Assume

edge distance = 30 mm

dia of bolt = 16 mm

strength of bolt = 25 KN

pitch = 45 mm

so, No. of bolts $= \frac{29.95}{25}$

$= 1.2$

$\simeq 2$ bolts.

$b_s = 75 + 95 - 10$

$w = 75\,mm$, $L_c = 40\,mm$

$t = 10\,mm$

$\therefore \beta = 1.4 - 0.076 \times \frac{w}{t} \times \frac{f_y}{f_u} \times \frac{b_s}{L_c} \le \frac{f_u \gamma_{m0}}{f_y \gamma_{m1}} \ge 0.7$

$\beta = 1.4 \cdot 0.076 \times \frac{75}{10} \times \frac{250}{410} \times \frac{160}{45} \le \frac{410 \times 1.10}{250 \times 1.25} > 0.7$

$\beta = 0.164 \le 1.4437$ (ok)

≥ 0.7 (Not ok)

Adopt $\beta = 0.7$

$A_{nc} = \left(125 - 18 - \frac{10}{2}\right) \times 10 = 1020\,mm^2$

$A_{go} = 75 \times 10 = 750\,mm^2$

$T_{dn} = 0.9 A_{nc} \frac{f_y}{\gamma_{m1}} + \beta A_{go} \frac{f_y}{\gamma_{m0}}$

$T_{dn} = 0.9 \times 1020 \times \frac{410}{1.25} + 0.7 \times 750 \times \frac{250}{1.1}$

$T_{dn} = 420.4\,kN$

$\therefore$ Design tensile strength $T_d = \min\{T_{dg}, T_{dn}\}$

$T_d = 420.4\,kN > 29.95\,kN$ (ok)

Tension in safe for section $125 \times 75 \times 10$

Design for Column

Axial compressive force, $P_u = 856.41\ kN$

Major axis moment, $M_z = 14.5923 \times 10^3\ kN-mm$

Minor axis moment, $M_y = 0$

Using E250 grade of steel.

Assuming the strength of all joints are more than the yield stress of compressive member.

Calculation for Effective Compressive Load:

$$P_{eff} = P_u + \frac{2M_z}{d} + \frac{7.5M_y}{b}$$

Let us try ISWB 600@ 1423 kN/m

$A = 18514.04\ mm^2$

$h = 600mm$

$b_f = 250mm$

$t_f = 23.6mm$

$t_w = 11.8\ mm$

$r_{zz} = 250.1\ mm$

$r_{yy} = 53.5\ mm$

$r_1 = 18\ mm$

$d = h - 2(t_f + r_1)$

$= 600 - 2(23.6 + 18)$

$d = 516.8mm$

$$\therefore P_{eff} = P_u + \frac{2M_z}{d} + \frac{7.5M_y}{b} \quad (\because M_y = 0)$$

$$= 856.41 + \frac{2(14.5923 \times 10^3)}{516.8} + \frac{(7.5)10}{250}$$

$P_{eff} = 912.88\ kN$

Section Classification (To find buckling class):

From Table 10 of IS 800:2007

$$\frac{h}{b_f} = \frac{600}{250} = 2.4 > 1.2$$

$t_f = 23.6\text{ mm} \le 40\text{mm}$

Buckling about y-y axis

∴ Buckling class = b

· Design compressive strength:

$L = 10\text{m} = ~~1000\text{mm}~~ 10000\text{ mm}$

$k = 0.8$ (from Table 11)

$r = r_{yy} = 53.5\text{ mm}$

$$\therefore \frac{kL}{r} = \frac{0.8 \times 10000}{53.5} = 149.53$$

$\therefore \lambda = 149.53$

Using Table 9(c) of IS 800:2007

for $\frac{kL}{r} = 149.53$ and $f_y = 250\text{MPa}$

we get, $f_{cd} = 64\text{ N/mm}^2$

∴ Design compressive load, $P_{cd} = f_{cd} \times A$

$= 64 \times 18514.04$

$= 1184.9\text{ kN} > P_{eff}\ (= 912.88\text{ kN})$

∴ The given member is safe under compression nsile capacity

$$T_{dg} = \frac{f_y}{\gamma_{mo}} \times A_g$$

$$= \frac{250}{1.10} \times 18514.04$$

$= \cancel{4207.4}$

$= 4207.8$ kN $(> 856.41 kN)$

he member will be safe in tensile force

Since the tensile force is very less.

ear force:

Applied shear force $= 0$.

4)