NAME	SALMAN AHMED
ID	NO # 0864
SECTION	NO # B.
PAPER	STEEL STRUCTURE
DATE	29/09/2020.
DEPARTMENT	BE(CIVIL)
UNIVERSITY	IQRA NATIONAL University PESHAWAR PHASE II.

Scanned with CamScanner

Q: NO: 01 :>

Given Data

W shap- column

steel = A36

D.L = 60K

L.L = 110K

Pin Supported at top & bottom

$K_x L_x$ = 36ft $K_y L_y$ = 18ft

AISC / LRFD

Sollution:>

step 01 :>

Required capacity:>

(1.2x60) + (1.6x 110)

=> 248K

step 02 :>

Enter Design strength Table of manual with K.L = 18ft & P = 248k

step 03 :>

some possible Section are.

1 - W14x61 P = 364 r_x/r_y = 2.44

2 - W12x53 P = 320 r_x/r_y = 2.11

3- W10x49   P = 301 r_x/r_y = 1.71

4- W18x58   P = 300k r_x/r_y = 1.74

Step 04:

If $\frac{r_x}{r_y} > \frac{K_x L_x}{K_y L_y}$

week axi's will control & Tabulated values are appropriate.

Step 05:

$$\frac{K_x L_x}{K_y L_y} = \frac{36}{18} = 2$$

Step 06:

Try W12x53 r_x/r_y = 2.11

$r_x = 5.23$, $r_y = 2.48$ $A = 15.6\ in^2$

$$\frac{K_x L_x}{r_x} = \frac{36 \times 12}{5.23} = 82.6$$

$$\frac{K_y L_y}{r_y} = \frac{18 \times 12}{2.48} = 87.09$$

$$\frac{KL}{r} = 87.09$$

STEP 07 :→ ~~3.08~~ 3.1

$$\lambda_c = \frac{K \cdot L}{r \pi} \sqrt{F_y/E}$$

$$= \frac{87.09}{\pi} \sqrt{\frac{36}{29,000}}$$

$$= 0.97 < 1.5$$

STEP 08 :→

$$F_{cr} = 0.658^{\lambda_c^2} \times F_y$$

$$F_{cr} = 0.658^{(.97)^2} \times 36$$

$$F_{cr} = 24.28$$

STEP 09

$$P_n = A_g F_{cr}$$

$$P_n = 15.6 \times 24.28$$

$$P_n = 378.78K$$

$$\phi P_n = 0.85 \times 378.78$$

$$= 321.96 > 248K$$

so check ① is OK

so W12x53 should be use.

Q : NO , 09

Given Data:→

Lightest w. section

⇒ D.L = 1.5 K

⇒ L.L = 4.5 K

At each quator point

⇒ Total length = 52'

⇒ Live load Deflection = 1/360 of span

⇒ F_y = 36 ksi

AISC / ASD Method:

Sollution:→

Design load = ϕ D.L + L.L

= 1.5 + 4.5

⇒ 6 K

So P = 6K

Deflection = $\Delta = \frac{5}{48} \times \frac{ML^2}{EI}$ → (1)

Δ by This equation is multiplied by the factor from <u>table 5.4</u>

$$M = \left(\frac{3}{2} \times 6 \times 26\right) - (6 \times 13) = 156\ k.ft$$

eq(1)

$$I = \frac{5}{48} \times \frac{ML^2}{E\Delta}$$

$$I = \frac{5}{48} \times \frac{(156 \times 12) \times (52 \times 12)^2}{29{,}000\left(\frac{52}{360} \times 12\right)}$$

$$I = 1510.51\ in^4$$

Try $W_{24 \times 62}$

$I_x = 1550\ in^2$

$b_f = 7.04\ in$

$d/A_f = 5.72$

$$L_c = \frac{76\ b_f}{\sqrt{f_y}}$$

$$\Rightarrow L_c = \frac{76 \times (7.04)}{\sqrt{36}}$$

$\Rightarrow L_c = 89'' = 7.41'$

$$L = \frac{20,000}{f_y \; d/A_f}$$

$$L = \frac{20,000}{36 \times 5.72}$$

$$L = 97.12'' = 8.09'$$

$$L > L_c$$

From Table 5.2

$$C_b = 1.13$$

$$\sqrt{\frac{102,000 \, C_b}{f_y}}$$

$$\Rightarrow \sqrt{\frac{102,000 \times 1.13}{36}}$$

$$\boxed{\Rightarrow 57}$$

$$\sqrt{\frac{510,000 \, C_b}{F_y}}$$

$$\Rightarrow \sqrt{\frac{510,000 \times 1.13}{36}}$$

$$\Rightarrow 127$$

$$\frac{L}{r_T} = \frac{13 \times 12}{1.71}$$

$$\Rightarrow 91.22$$

condition:

$$\sqrt{\frac{102{,}000\, C_b}{f_y}} \leq \frac{L}{r_T} \leq \sqrt{\frac{510000\, C_b}{f_y}}$$

$$57 \leq 91.22 \leq 127$$

So

$$F_b = \left[\frac{2}{3} - \frac{F_y\,(L/r_T)^2}{1530 \times 10^3 \times C_b}\right] F_y$$

$$F_b = \left[\frac{2}{3} - \frac{36 \times (91.22)^2}{1530 \times 10^3 \times 1.13}\right] \times 36$$

$$\Rightarrow F_b = 17.76\,\text{ksi} \quad \text{allowable}$$

Assume the Beam Self weight $= 62\ \frac{lb}{ft}$

$= 0.062\ \frac{k}{ft}$

$$M = \frac{wL^2}{8}$$

$$\Rightarrow M = \frac{0.062 \times 52^2}{8}$$

$$\Rightarrow M = 20.95\ \text{k}\cdot\text{ft}$$

Total

$M = 156 + 20.95$

$M = 176.95$

$f_b = \frac{M}{S_x} = \frac{176.95 \times 12}{131}$

$f_b = 16.2\,ksi$

check.

$f_b < F_b$

$16.2\,ksi < 17.76\,ksi$

So check is ok &

We can use

$W_{24 \times 62}$

-3+3.
3,1

Q : NO: 03 :→

Given Data:→

Length = L = 18ft

Dead load = D·L = 50k

Live load = L·L = 150k

bolts = A325, 3/4" dia.

connection Type = Bearing

steel = A36

Threads not Excluded.

Required Data:→

A36 Doubl Angle Tension.

Sollution:-

Total Load = D·L + L·L

= 50 + 150

= 200 kips

OR

100 kips/Angle.

For yeilding at gross area allowable stresses are

$0.6 F_y \Rightarrow 0.6 \times 36$

= 22 ksi

Scanned with CamScanner

3, 2

For fracture at net area allowable stresses are

$0.5 F_u = 0.5 \times 58$

$= 29 ksi$

As connection is not bolted so

$A_g \neq A_n$

Now

$A_e = 0.85 A_n$

For yeilding

$A_g \times 22 = 100$

$A_g = 100/22$

$A_g = 4.5 \ in^2$

For Fracture

$29 \times A_e = 100$

$A_e = 100/29$

$A_e = 3.45 \ in^2$

$A_n = A_e/.85 = 4.05 \ in^2$

Assum 15% reduction in gross area for holes.

So

$\Rightarrow A_g = \frac{A_n}{0.85} =$

$\Rightarrow A_g = \frac{4.05}{0.85}$

$\Rightarrow A_g = 4.76 \ in^2$

For

$6 \times 4 \times \frac{1}{2}$ $A = 4.75 in^2 \approx 4.76 in^2$

$r_x = 1.91$

$r_y = 1.15$

$\frac{L}{r_{min}} = \frac{18 \times 12}{1.15}$

$= 187.82$

$187.82 \leq 300$ OK.

Design For bolts:>

Usin A325 bolt Threads not exclude.

$A = 0.44 in^2$

$dia = 3/4''$

Allowable bolt shear = 21 ksi → [Table 2.11 Gaylord]

Since

The bolts are in double shear

So

⇒ Allowable bolts bearing stress = $1.2 F_u$

⇒ 1.2×58

⇒ 69.6 ksi

⇒ Allowable shear per bolt =

⇒ $2 \times 21 \times 0.44$

⇒ 18.5 kips.

⇒ Allowable bearing on Two 7/16" thick angle long legs = $69.6 \times 2 \times \frac{7}{16} \times 0.75$

⇒ 45.68 kips > 18.5 kips.

So

Shear governs.

Now

Number of bolts ⇒ $\frac{200}{18.5}$

⇒ 10.81

So we ~~can~~ will use 12 bolts.

Design of Gusset plate:→

Bearing stress = 1.2 Fu

⇒ 1.2×58

⇒ 69.6 ksi

So

Allowable bearing =

$$69.6 \times 12 \times 0.75 \times t = 200$$

$$\Rightarrow t = 0.32 \text{ in}$$

Use 3/4" G.P

Checking various limit state:→

$$\text{yeilding} = 0.6 F_y A_g$$

$$= 0.6 \times 36 (10 \times .75)$$

$$\Rightarrow 162 \text{ kip} < 200 \text{ kips.}$$

Not ok.

3,6

Try $L\,7 \times 4 \times \frac{1}{2}$ $A_g = 5.25$

$r_x = 2.25$, $r_y = 1.11$ with $\frac{3}{8}$ G.P

$$\frac{L}{r_{min}} = \frac{18 \times 12}{1.11}$$

$$= 194.59 \le 300k$$

OK.

Allowable bearing on Two 1/2" Thick angle long legs =

$$69.6 \times 2 \times \frac{1}{2} \times 0.75$$

$$52.2 > 18.5$$

OK

So Shear governs.

Checks for various limit state:

yeilding

$$0.6 F_y A_g$$

$$\Rightarrow 0.6 \times 36 (14 \times 0.75)$$

$$\Rightarrow 226.8 > 200k$$

OK.

Fracture

$0.5 \times Fu \times Ae$

$\Rightarrow 0.5 \times 58 \times 0.85 [14 - (\frac{3}{4} \times 2)] \times 3/4$

$\Rightarrow 231k > 200k$

OK.

check for Tearing failure:

$$Le = \frac{2P}{Fut}$$

$$\Rightarrow 1.25 = \frac{2P}{58 \times 0.5}$$

$$\Rightarrow \frac{1.25 \times 58 \times 0.5}{2} = P$$

$$P = 18.125\ k.$$

$$L = \frac{2P}{fut} + \frac{d_n}{2}$$

$$2 \times (58 \times 0.5) = 2P + 0.375$$

$$\Rightarrow 2P = 116.1 - 0.375$$

$$P = 57.86\ k.$$

3, 8

capacity

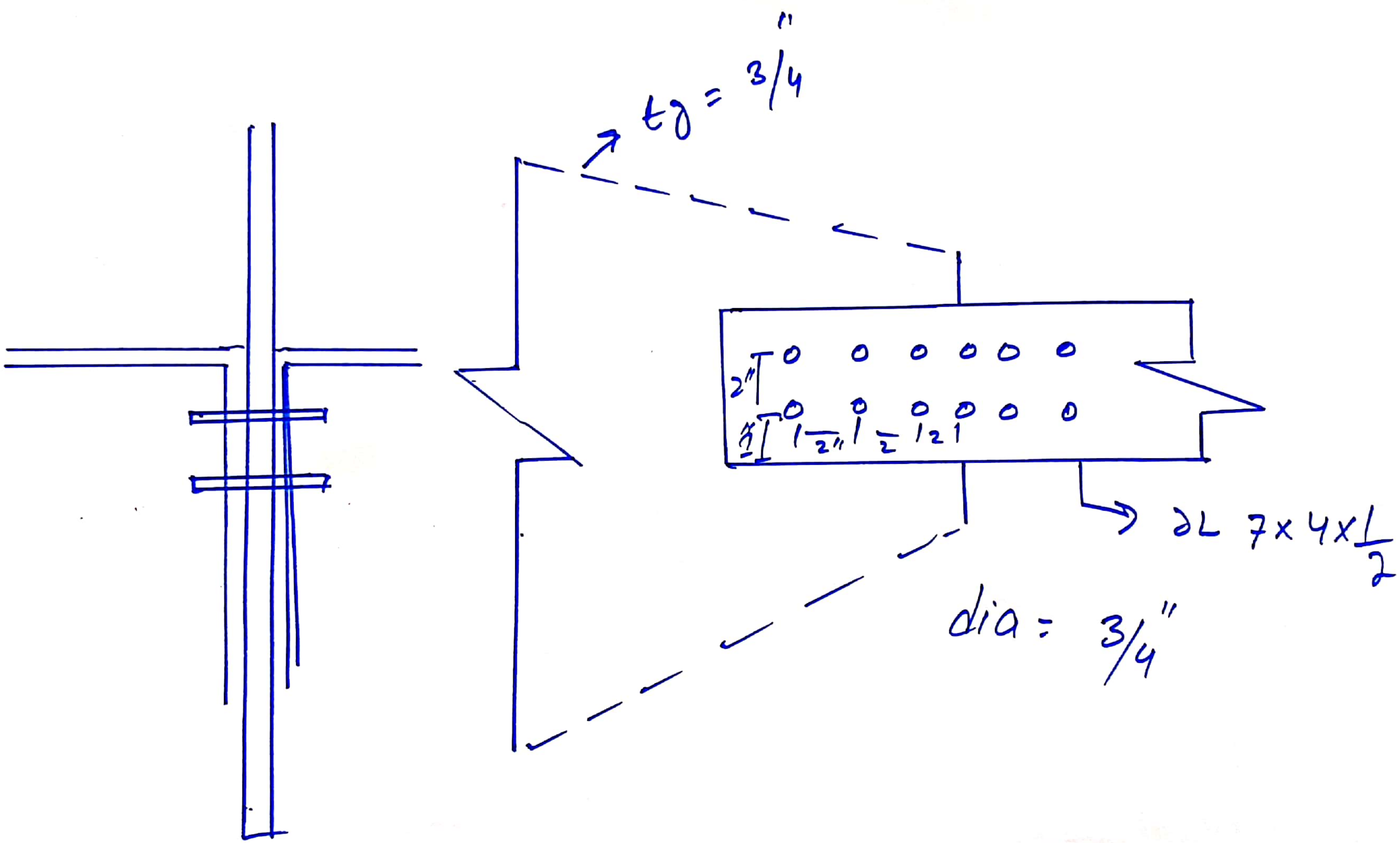
since 12 bolts. & ∅ 6 bolts

per row

$\Rightarrow (2 \times 18.125) + (8 \times 57.86)$

$36 + 462.88$

$\Rightarrow 498.88k > 200k$


tg = 3/4"
2"
2"
2L 7x4x1/2
dia = 3/4"