



	0	7/8/2006	ISSUED for APPROVAL	M.B	M.B
	Rev. No.	Date	Description	Prepared By	Checked By
	Title : <p style="text-align: center; color: red; font-size: 1.2em;">Steel Structure Calculation Notebook</p>				
	Project : <p style="text-align: center; color: red; font-size: 1.2em;">Mill Bent</p>				
	Owner : <p style="text-align: center; color: red; font-size: 1.2em;">Mr. Zahmatkesh</p>				
Owner Project Document	Project Number	Project Document	Number of Sheets (Cover Excluded)		Revision Number
---	001		A3 Sheet	---	
			A2 Sheet	---	
			Total Sheet	---	0

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	Number		Designer	M.B		
Date : July 8, 2006			Proj. Title	Mill Bent		
Structure Type	Steel M.R.F		Subject	Index sheet		

Introduction :

Scope of work :

This calculation notebook covers the loading , modeling , analysing and designing of a mill bent steel structure for Mr. Behzad Nia in Akbar Abad , Shiraz.

This mill bent contains 1 span with 15.50 m length and consists of 6 frames with distance of 7.30 m length. Also a crain with 5.00 Ton capacity has defined for this structure. the height of crane is 4.50 m under the hook.

The slope of roof is approximately 19.50%.

Language :

All of the calculations , documents and drawings are written in english.

Codes and standards :

It's most common use of these codes and standards is as follows :

- 1- Iranian code No.519
- 2- Iranian code No.2800
- 3- AISC code (American Institute of Steel Constructions)
- 4- Design of steel structures (Mr. Tahooni)
- 5- Design of steel mill bents (Mr. Kormi)
- 6- Iranian national building code part 10
- 7- Iranian structural welding code No.228
- 8- Design of steel structure connections (Mr. Tahooni)
- 9- Design of baseplates (Mr. Ghalibafian)

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About the structural model :

Structure design code : AISC-ASD1989

Frame type : Ordinary moment frame along X direction & braced frame along Y direction

Software for structure modelling :

Structure modelling type : 3D

Allowable soil stress : $q_{all} = 1.50 \text{ Kg/Cm}^2$

Software for foundation modelling & designing : Safe ver. 7.3.3

Foundation type : Pad foundation + footing beams

Materials :

Structural steel material : ST 37-3

High strength bolts : A-325 Class 8.8

Common bolts : A-307 Class 8.8

Welding electrodes : E-6010 & E-6013 & E-7018

Strength and allowable stresses :

Steel structures :

$F_y = 2400 \text{ Kg/Cm}^2$

$F_u = 3700 \text{ Kg/Cm}^2$

$F_t = 0.6 F_y = 1440 \text{ Kg/Cm}^2$ (On the gross area)

$F_t = 0.5 F_u = 1850 \text{ Kg/Cm}^2$ (On the effective net area)

Note :

F_p , F_a , F_b and F_v are varriable according to cods and section geometries.

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High strength bolts :

F_u : 7250 Kg/Cm² (A-325 Class 8.8 & $d > 25\text{mm}$)

F_u : 8250 Kg/Cm² (A-325 Class 8.8 & $d \leq 25\text{mm}$)

F_v : 0.20 F_u (Kg/Cm²)

Common bolts :

F_u : 4200 Kg/Cm² (A-307 Class 8.8)

F_v : 0.17 F_u (Kg/Cm²)

Note :

F_t is variable according to cods and reaction forces.

Bars :

The material used for bolts & foundation bars is considered as follow :

Type AII : F_y = 3000 Kg/Cm² F_u = 5000 Kg/Cm²

Welds :

Welding electrode : AWS E-6010 & AWS E-6013 & AWS E-7018

Groove welds with complete or incomplete penetration :

F_t : Proportionate to base metal.

F_a : Proportionate to base metal.

F_v : 0.3 F_{ue} (Kg/Cm²)

Fillet welds :

F_t : (Parallel to weld axis) Proportionate to base metal.

F_a : (Parallel to weld axis) Proportionate to base metal.

F_v : 0.3 F_{ue} (On effective section) (Kg/Cm²)

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Concrete :

The minimum strength of test cylinder for foundation is considered as follow:

$$F_c' = 210 \text{ Kg/Cm}^2$$

Also the concrete cover foundation for button is 7.5 Cm and for top is 5.0 Cm.

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Dead load :

1 - Roof

No.	Description	W (Kg/m ³)	Thk. (m)	W (Kg/m ²)
1	Corrugated iron roofing	---	---	5
2	Roof insulation	---	---	5
$\sum W =$				10.00

2 - Exterior faced walls :

No.	Description	W (Kg/m ³)	Thk. (m)	W (Kg/m ²)
1	Face brick and cement mortar	1850	0.100	185
2	Eng. brick and cement mortar	850	0.250	212.5
3	Face brick and cement mortar	1850	0.100	185
$\sum W =$				582.50
Take $\sum W =$				585

Note :

Steel structure weight like beams, columns and purlins has considered
in structural model for analysis.

Snow load :

City	Zoon	Snow load (Kg/m ²)
Darab	2	100

Note :

This kind of load must be applied as uniform disributed load on horizontal situation.

Earthquake load :

City	Province	Zoon Code	Acceleration
Darab	Fars	2	0.30

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Structure identification :

X direction :

$$T_0 = 0.700$$

$$H = 7.000 \text{ m}$$

$$T = 0.344 \text{ Sec.}$$

$$B = 2.750$$

$$I = 1.000$$

$$R = 7.000$$

$$C_x = 0.118$$

Y direction :

$$T_0 = 0.700$$

$$H = 7.000 \text{ m}$$

$$T = 0.215 \text{ Sec.}$$

$$B = 2.750$$

$$I = 1.000$$

$$R = 6.000$$

$$C_y = 0.138$$

Structure effective weight calculation :

Story	Dead Load (Ton)	Wall Load (Ton)	W _i (Ton)	H _i (m)	W _i .H _i (Ton.m)	Fix (Ton)
Roof	30.00	140.00	170.00	7.00	1190.00	20.036
$\Sigma W_i.H_i =$					1190.000 T.m	$V_x =$ 20.036 Ton

Story	Dead Load (Ton)	Wall Load (Ton)	W _i (Ton)	H _i (m)	W _i .H _i (Ton.m)	F _{iy} (Ton)
Roof	30.00	140.00	170.00	7.00	1190.00	23.375
$\Sigma W_i.H_i =$					1190.000 T.m	$V_y =$ 23.375 Ton

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Wind load :

According to Iranian code No.519 :

City	Wind velocity (Km/hrs)	Wind datum pressure (Kg/m2)
Darab	80	32

For zone No. 2 :

$$C_e = 2.000$$

Descriptions			C _q	P (Kg/m2)
Walls	Windward		0.80	51.20
	Leeward		-0.50	-32.00
	Parallel to wind		-0.70	-44.80
Roofs	Flat		-0.70	-44.80
	Sloped & Windward	Slope < 15°	-0.70	-44.80
		15° ≤ Slope ≤ 30°	-0.70	-44.80
		15° ≤ Slope ≤ 30°	0.40	25.60
		31° ≤ Slope ≤ 45°	0.40	25.60
		Slope > 45°	0.80	51.20
	Sloped & Leeward		-0.70	-44.80
	Parallel to wind		-0.70	-44.80

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Load combinations :

According to Iranian code No.519 :

- 1 - DL
- 2 - DL + SL
- 3 - DL + Dr.L
- 4 - DL + WL_{x/y}
- 5 - DL + EL_{x/y}
- 6 - DL + SL/2 + WL_{x/y}
- 7 - DL + SL/2 + EL_{x/y}
- 8 - DL + Dr.L/2 + WL_{x/y}
- 9 - DL + Dr.L/2 + EL_{x/y}
- 10 - DL + SL + WL_{x/y}/2
- 11 - DL + Dr.L + WL_{x/y}/2
- 12 - DL + SL + EL_{x/y}
- 13 - DL + Dr.L + EL_{x/y}

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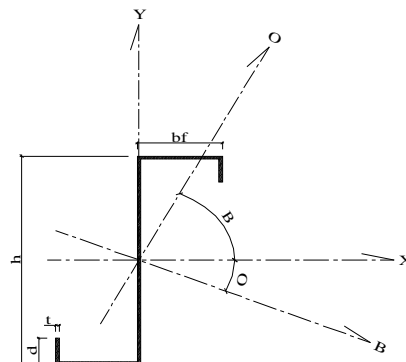
Purlin type 1 :

According to loading sheet :

DL : 10.00 Kg/m2 (gravity direction)

SL : 100.00 Kg/m2 (horizontal situation)

α : 11.310 ° Fy : 2400 Kg/Cm2



Try Z profile 200 x 50 x 2 mm :

Ixx : 378.74 Cm4

Iyy : 32.29 Cm4

Ixy : 78.28 Cm4

Tan 2θ : -0.452

2θ : -24.317 ° ∴ θ : -12.159 ° ∴ β : 77.841 °

Iβ : 395.61 Cm4

Iθ : 15.43 Cm4

Cθ : 10.808 Cm

Cβ : 3.105 Cm

Sβ : 36.604 Cm3

Sθ : 4.968 Cm3

W : 103.9 Kg/m2 (gravity direction)

wθ : 103.891 S* Kg/m

*- S : Distance between purlins.

wβ : 1.539 S* Kg/m

Distance between frames : 6.000 m

Number of sagrods for purlins : 2

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M_{ls} : 467.508 S* Kg.m

*- S : Distance between purlins.

M_{ϕ} : 0.616 S* Kg/m

Fb : 1440 Kg/Cm2

$f_{b\beta}$: 1277.19 S Kg/Cm2

$f_{b\theta}$: 12.39 S Kg/Cm2

fb : 1289.58 S Kg/Cm2

Sreq : 1.117 m ∴ Take S : 1.00 m

Deflection control :

$\Delta_{all} = L / 240$: 2.5000 Cm

Δ_{max} : 2.1830 Cm ☺

Purlin type 1 :

Use Z profile : 200 x 50 x 2 mm @ 1000 mm

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Sag rod type 1 :

According to loading sheet :

DL : 15.21 Kg/m2 (gravity direction)

SL : 100.00 Kg/m2 (horizontal situation)

α : 11.310 ° Fy : 2400 Kg/Cm2 Fu : 3700 Kg/Cm2

W : 22.214 Kg/m2 (gravity direction)

Try 2 lines of sag rods for every span:

Distance between frames : 6.000 m

T : 453.08 Kg

Ft : 1221 Kg/Cm2 ∴ Areq. : 0.371 Cm2

Lreq. : 1150 mm

Sag rod type 1 :

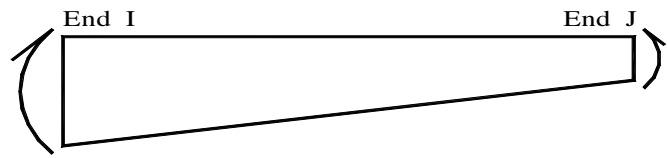
Use Ø 10 mm , L = 1150 mm

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Beam type 1 :

End I :		
P	0.138	Ton
V	0.771	Ton
M _x	0.748	T.m
M _y	0.167	T.m

End J :		
P	0.000	Ton
V	0.000	Ton
M _x	0.000	T.m
M _y	0.000	T.m



F_y : 2400 Kg/Cm2 L : 1.000 m

E_s : 2.03E+06 Kg/Cm2

α : 11.310 °

Section I-I		
bf	200	mm
tf	10	mm
d	200	mm
tw	6	mm

Basic Properties for Section I-I						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
52.00	4813.33	1333.69	437.58	133.37	9.62	5.06

bf/2tf : 10.000 ≤ 16.269 ☺

d/tw : 33.333 ≤ 342.316 ☺

Section J-J		
bf	200	mm
tf	10	mm
d	100	mm
tw	6	mm

Basic Properties for Section J-J						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
46.00	1263.33	1333.51	210.56	133.35	5.24	5.38

bf/2tf : 10.000 ≤ 16.269 ☺

d/tw : 16.667 ≤ 342.316 ☺

Control for section I-I :

K_x : 1.000 L_{ux} : 102 Cm

K_y : 1.000 L_{uy} : 100 Cm

K.L/r_x : 10.6

K.L/r_y : 19.746

C_c : 129.21 ∴ C_c > (K.L/r)_{max} ∴ F_s : 1.724
F_a : 1376.23 Kg/Cm2

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f_a : 2.65 Kg/Cm2 ☺

f_a/F_a : 0.002 ≤ 0.15

C_{mx} : ---

$|M_{1y}|$: --- T.m

$|M_{2y}|$: --- T.m

C_{my} :

$b_f/2t_f$: 10.000 ≤ 11.125 ☺

d/t_w : 33.333 ≤ 109.080 ☺

L_{ux} : 100 ≤ min (260.054 & 585.833) ☺ ∴ The section is compact !

h_t : 3.333 Cm $|M_{1x}|$: --- T.m

A_t : 22.000 Cm² $|M_{2x}|$: 0.748 T.m

I_{yy} : 666.673 Cm⁴ C_b : 1.750

r_t : 5.505 Cm

λ_t : 18.166

λ_B : 72.306

λ_C : 161.68 ∴ $\lambda < \lambda_B$ ∴ F_{b1} : 1440.00 Kg/Cm²

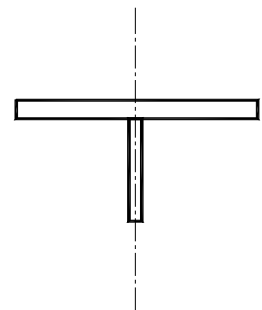
F_{b2} : 13420.91 Kg/Cm²

F_{bx} : 1440.00 Kg/Cm²

F_{by} : 1440.00 Kg/Cm²

f_{bx} : 170.94 Kg/Cm²

f_{by} : 125.22 Kg/Cm²



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Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.002	0.119	0.087	$0.208 \leq 1.000$ ☺

For section I-I :

Use BH : 200 x 220 x 10 x 6 mm

Control for section J-J :

K_x : 1.000 L_{ux} : 102 Cm

K_y : 1.000 L_{uy} : 100 Cm

$K.L/r_x$: 19.46

$K.L/r_y$: 18.573

C_c : 129.21 $\therefore C_c > (K.L/r)_{max} \therefore F_s$: 1.723
 F_a : 1377.35 Kg/Cm2

f_a : 0.00 Kg/Cm2 ☺

f_a/F_a : 0.000 ≤ 0.15

C_{mx} : ---

$|M_{1y}|$: --- T.m

$|M_{2y}|$: ---

C_{my} :

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$$b_f/2t_f : 10.000 \leq 11.125 \quad \text{☺}$$

$$d/t_w : 16.667 \leq 109.080 \quad \text{☺}$$

$$L_{ux} : 100 \leq \min (260.054 \quad \& \quad 1171.667) \quad \text{☺} \therefore \text{The section is compact !}$$

$$h_t : 1.667 \text{ Cm} \quad | M_{1x} | : --- \text{ T.m}$$

$$A_t : 21.000 \text{ Cm}^2 \quad | M_{2x} | : 0.748 \text{ T.m}$$

$$I_{yy} : 666.670 \text{ Cm}^4 \quad C_b : 1.750$$

$$r_t : 5.634 \text{ Cm}$$

$$\lambda_t : 17.748$$

$$\lambda_B : 72.306$$

$$\lambda_C : 161.68 \quad \therefore \lambda < \lambda_B \quad \therefore F_{b1} : 1440.00 \text{ Kg/Cm}^2$$

$$F_{b2} : 13420.91 \text{ Kg/Cm}^2$$

$$F_{bx} : 1440.00 \text{ Kg/Cm}^2$$

$$F_{by} : 1440.00 \text{ Kg/Cm}^2$$

$$f_{bx} : ---$$

$$f_{by} : ---$$

Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.000	0.000	0.000	$0.000 \leq 1.000 \quad \text{☺}$

For section J-J :

Use BH : 200 x 120 x 10 x 6 mm

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Control for Shear :

Try a : 1 Cm

h : 20.00 Cm

a / h : 0.05 < 1.00

k : 2140.00

Cv : 45.127 < 0.80

Fv : 960 Kg/Cm2

fv : 128.50 Kg/Cm2 ☺

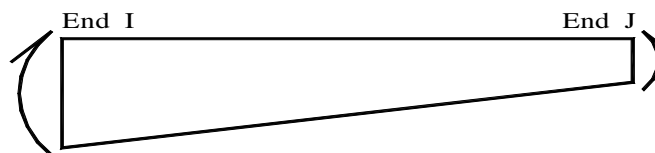
h / tw : 33.33 < 260 ∴ Middle stiffener is not required !

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Beam type 2 :

End I :		
P	4.500	Ton
V	6.330	Ton
M _x	22.520	T.m
M _y	0.070	T.m

End J :		
P	4.500	Ton
V	4.710	Ton
M _x	5.580	T.m
M _y	0.000	T.m



F_y : 2400 Kg/Cm2 L : 3.000 m

E_s : 2.03E+06 Kg/Cm2

α : 11.310 °

Section I-I		
bf	250	mm
tf	10	mm
d	800	mm
tw	6	mm

Basic Properties for Section I-I						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
98.00	107616.67	2605.61	2624.80	208.45	33.14	5.16

bf/2tf : 12.500 ≤ 16.269 ☺

d/tw : 133.333 ≤ 342.316 ☺

Section J-J		
bf	250	mm
tf	10	mm
d	400	mm
tw	6	mm

Basic Properties for Section J-J						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
74.00	24216.67	2604.89	1153.17	208.39	18.09	5.93

bf/2tf : 12.500 ≤ 16.269 ☺

d/tw : 66.667 ≤ 342.316 ☺

Control for section I-I :

K_x : 1.000 L_{ux} : 306 Cm

K_y : 1.000 L_{uy} : 100 Cm

K.L/r_x : 9.2323

K.L/r_y : 19.394

C_c : 129.21 ∴ C_c > (K.L/r)_{max} ∴ F_s : 1.723
F_a : 1377.61 Kg/Cm2

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f_a : 45.92 Kg/Cm2 ☺

f_a/F_a : 0.033 ≤ 0.15

C_{mx} : ---

$|M_{1y}|$: --- T.m

$|M_{2y}|$: --- T.m

C_{my} :

$b_f/2t_f$: 12.500 > 11.125 ☹

d/t_w : 133.333 > 101.695 ☹

L_{ux} : 300 > min (325.068 & 183.073) ☹ ∴ *The section is non-compact !*

h_t : 13.333 Cm $|M_{1x}|$: 5.580 T.m

A_t : 33.000 Cm² $|M_{2x}|$: 22.520 T.m

I_{yy} : 1302.107 Cm⁴ C_b : 2.029

r_t : 6.282 Cm

λ_t : 47.759

λ_B : 77.849

λ_C : 174.07 ∴ $\lambda < \lambda_B$ ∴ F_{b1} : 1440.00 Kg/Cm²

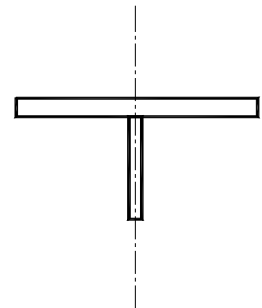
F_{b2} : 1739.14 Kg/Cm²

F_{bx} : 1440.00 Kg/Cm²

F_{by} : 1440.00 Kg/Cm²

f_{bx} : 857.97 Kg/Cm²

f_{by} : 33.581 Kg/Cm²



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Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.033	0.596	0.023	$0.652 \leq 1.000$ ☺

For section I-I :

Use BH : 250 x 820 x 10 x 6 mm

Control for section J-J :

K_x : 1.000 L_{ux} : 306 Cm

K_y : 1.000 L_{uy} : 100 Cm

$K.L/r_x$: 16.912

$K.L/r_y$: 16.855

C_c : 129.21 $\therefore C_c > (K.L/r)_{max} \therefore F_s$: 1.715
 F_a : 1387.05 Kg/Cm²

f_a : 60.81 Kg/Cm² ☺

f_a/F_a : 0.044 ≤ 0.15

C_{mx} : ---

$|M_{1y}|$: --- T.m

$|M_{2y}|$: ---

C_{my} :

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$b_f/2t_f : 12.500 > 11.125 \quad \ominus$

$d/t_w : 66.667 \leq 101.695 \quad \odot$

$L_{ux} : 300 \leq \min (325.068 \quad \& \quad 366.146) \quad \odot \therefore \text{The section is non-compact !}$

$h_t : 6.667 \text{ Cm} \quad | M_{1x} | : 5.580 \text{ T.m}$

$A_t : 29.000 \text{ Cm}^2 \quad | M_{2x} | : 22.520 \text{ T.m}$

$I_{yy} : 1302.095 \text{ Cm}^4 \quad C_b : 2.029$

$r_t : 6.701 \text{ Cm}$

$\lambda_t : 44.771$

$\lambda_B : 77.849$

$\lambda_C : 174.07 \therefore \lambda < \lambda_B \therefore F_{b1} : 1440.00 \text{ Kg/Cm}^2$

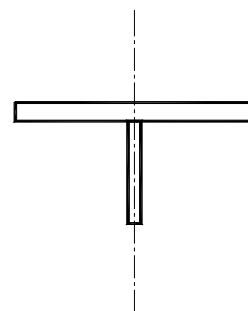
$F_{b2} : 1739.14 \text{ Kg/Cm}^2$

$F_{bx} : 1440.00 \text{ Kg/Cm}^2$

$F_{by} : 1440.00 \text{ Kg/Cm}^2$

$f_{bx} : 483.88 \text{ Kg/Cm}^2$

$f_{by} : ---$



Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.044	0.336	0.000	$0.380 \leq 1.000 \quad \odot$

For section J-J :

Use BH : 250 x 420 x 10 x 6 mm

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Control for Shear :

Try a : 1 Cm

h : 80.00 Cm

a / h : 0.01 < 1.00

k : #####

Cv : 45.088 < 0.80

Fv : 960 Kg/Cm2

fv : 263.75 Kg/Cm2 ☺

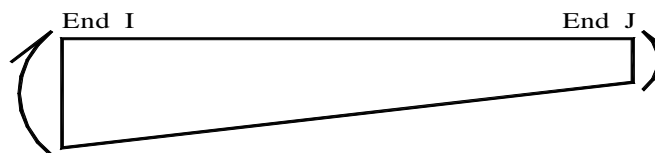
h / tw : 133.33 < 260 ∴ Middle stiffener is not required !

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Beam type 3 :

End I :		
P	1.600	Ton
V	2.730	Ton
M _x	12.670	T.m
M _y	0.000	T.m

End J :		
P	1.600	Ton
V	1.370	Ton
M _x	-2.080	T.m
M _y	0.000	T.m



F_y : 2400 Kg/Cm2 L : 7.100 m

E_s : 2.03E+06 Kg/Cm2

α : 11.310 °

Section I-I		
b _f	250	mm
t _f	10	mm
d	400	mm
t _w	6	mm

Basic Properties for Section I-I						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
74.00	24216.67	2604.89	1153.17	208.39	18.09	5.93

b_f/2t_f : 12.500 ≤ 16.269 ☺

d/t_w : 66.667 ≤ 336.707 ☺

Section J-J		
b _f	250	mm
t _f	10	mm
d	400	mm
t _w	6	mm

Basic Properties for Section J-J						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
74.00	24216.67	2604.89	1153.17	208.39	18.09	5.93

b_f/2t_f : 12.500 ≤ 16.269 ☺

d/t_w : 66.667 ≤ 336.707 ☺

Control for section I-I :

K_x : 1.000 L_{ux} : 724 Cm

K_y : 1.000 L_{uy} : 100 Cm

K.L/r_x : 40.025

K.L/r_y : 16.855

C_c : 129.21 ∴ C_c > (K.L/r)_{max} ∴ F_s : 1.779
F_a : 1284.27 Kg/Cm2

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f_a : 21.62 Kg/Cm2 ☺

f_a/F_a : 0.017 ≤ 0.15

C_{mx} : ---

$|M_{1y}|$: ---

$|M_{2y}|$: --- T.m

C_{my} :

$b_f/2t_f$: 12.500 > 11.125 ☹

d/t_w : 66.667 ≤ 105.842 ☺

L_{ux} : 710 > min (325.068 & 366.146) ☹ ∴ *The section is non-compact !*

h_t : 6.667 Cm $|M_{1x}|$: 2.080 T.m

A_t : 29.000 Cm2 $|M_{2x}|$: 12.670 T.m

I_{yy} : 1302.095 Cm4 C_b : 1.586

r_t : 6.701 Cm

λ_t : 105.96

λ_B : 68.828

λ_C : 153.9 ∴ $\lambda_B \leq \lambda \leq \lambda_C$ ∴ F_{b1} : 1220.81 Kg/Cm2

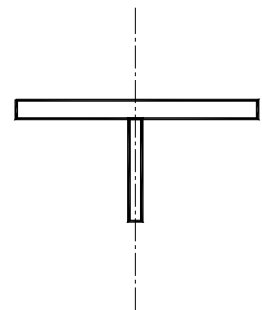
F_{b2} : 1121.48 Kg/Cm2

F_{bx} : 1220.81 Kg/Cm2

F_{by} : 1440.00 Kg/Cm2

f_{bx} : 1098.7 Kg/Cm2

f_{by} : ---



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Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.017	0.900	0.000	$0.917 \leq 1.000$ ☺

For section I-I :

Use BH : 250 x 420 x 10 x 6 mm

Control for section J-J :

K_x : 1.000 L_{ux} : 724 Cm
 K_y : 1.000 L_{uy} : 100 Cm

$K.L/r_x$: 40.025

$K.L/r_y$: 16.855

C_c : 129.21 $\therefore C_c > (K.L/r)_{max} \therefore F_s$: 1.779
 F_a : 1284.27 Kg/Cm2

f_a : 21.62 Kg/Cm2 ☺

f_a/F_a : 0.017 ≤ 0.15

C_{mx} : ---

$|M_{1y}|$: ---

$|M_{2y}|$: ---

C_{my} :

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$b_f/2t_f : 12.500 > 11.125 \quad \ominus$

$d/t_w : 66.667 \leq 105.842 \quad \odot$

$L_{ux} : 710 > \min (325.068 \quad \& \quad 366.146) \quad \ominus \therefore \text{The section is non-compact !}$

$h_t : 6.667 \text{ Cm} \quad | M_{1x} | : 2.080 \text{ T.m}$

$A_t : 29.000 \text{ Cm}^2 \quad | M_{2x} | : 12.670 \text{ T.m}$

$I_{yy} : 1302.095 \text{ Cm}^4 \quad C_b : 1.586$

$r_t : 6.701 \text{ Cm}$

$\lambda_t : 105.96$

$\lambda_B : 68.828$

$\lambda_C : 153.9 \quad \therefore \quad \lambda_B \leq \lambda \leq \lambda_C \quad \therefore \quad F_{b1} : 1220.81 \text{ Kg/Cm}^2$

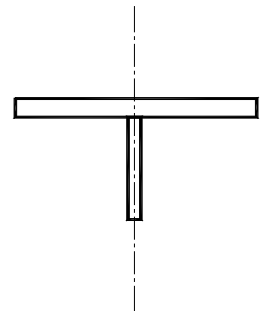
$F_{b2} : 1121.48 \text{ Kg/Cm}^2$

$F_{bx} : 1220.81 \text{ Kg/Cm}^2$

$F_{by} : 1440.00 \text{ Kg/Cm}^2$

$f_{bx} : 180.37 \text{ Kg/Cm}^2$

$f_{by} : ---$



Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.017	0.148	0.000	$0.165 \leq 1.000 \quad \odot$

For section J-J :

Use BH : 250 x 420 x 10 x 6 mm

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Control for Shear :

Try a : 700 Cm

h : 40.00 Cm

a / h : 17.50 \geq 1.00

k : 5.35

Cv : 1.129 \geq 0.80

Fv : 937.16 Kg/Cm2

fv : 113.75 Kg/Cm2 ☺

h / tw : 66.67 < 260 \therefore Middle stiffener is not required !

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f_a : 129.23 Kg/Cm2 ☺

f_a/F_a : 0.139 ≤ 0.15

C_{mx} : ---

$|M_{1y}|$: ---

$|M_{2y}|$: --- T.m

C_{my} :

$b_f/2t_f$: 12.500 > 11.125 ☹

d/t_w : 41.667 ≤ 87.475 ☺

L_{ux} : 600 > min (325.068 & 585.833) ☹ ∴ *The section is non-compact !*

h_t : 4.167 Cm $|M_{1x}|$: ---

A_t : 27.500 Cm² $|M_{2x}|$: 21.350 T.m

I_{yy} : 1302.091 Cm⁴ C_b : 1.750

r_t : 6.881 Cm

λ_t : 87.196

λ_B : 72.306

λ_C : 161.68 ∴ $\lambda_B \leq \lambda \leq \lambda_C$ ∴ F_{b1} : 1367.32 Kg/Cm²

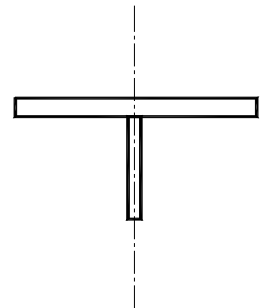
F_{b2} : 2278.24 Kg/Cm²

F_{bx} : 1440.00 Kg/Cm²

F_{by} : 1440.00 Kg/Cm²

f_{bx} : ---

f_{by} : ---



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Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.139	0.000	0.000	$0.139 \leq 1.000$ ☺

For section I-I :

Use BH : 250 x 270 x 10 x 6 mm

Control for section J-J :

$f/h : 0.333$ & $L/h : 3.333$ ∴ $K_x : 1.000$ $L_{ux} : 600$ Cm
 $K_y : 1.000$ $L_{uy} : 600$ Cm

$K.L/r_x : 18.106$

$K.L/r_y : 116.36$

$C_c : 129.21$ ∴ $C_c > (K.L/r)_{max}$ ∴ $F_s : 1.913$
 $F_a : 745.83$ Kg/Cm²

$f_a : 85.71$ Kg/Cm² ☺

$f_a/F_a : 0.115 \leq 0.15$

$C_{mx} : ---$

$|M_{1y}| : ---$

$|M_{2y}| : ---$

$C_{my} :$

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$$b_f/2t_f : 12.500 > 11.125 \quad \ominus$$

$$d/t_w : 133.333 > 87.475 \quad \ominus$$

$$L_{ux} : 600 > \min (325.068 \quad \& \quad 183.073) \quad \ominus \therefore \text{The section is non-compact !}$$

$$h_t : 13.333 \text{ Cm} \quad | M_{1x} | : ---$$

$$A_t : 33.000 \text{ Cm}^2 \quad | M_{2x} | : 21.350 \text{ T.m}$$

$$I_{yy} : 1302.107 \text{ Cm}^4 \quad C_b : 1.750$$

$$r_t : 6.282 \text{ Cm}$$

$$\lambda_t : 95.518$$

$$\lambda_B : 72.306$$

$$\lambda_C : 161.68 \quad \therefore \quad \lambda_B \leq \lambda \leq \lambda_C \quad \therefore \quad F_{b1} : 1320.78 \text{ Kg/Cm}^2$$

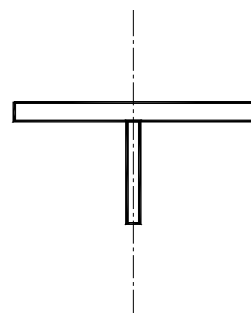
$$F_{b2} : 750.15 \text{ Kg/Cm}^2$$

$$F_{bx} : 1320.78 \text{ Kg/Cm}^2$$

$$F_{by} : 1440.00 \text{ Kg/Cm}^2$$

$$f_{bx} : 813.4 \text{ Kg/Cm}^2$$

$$f_{by} : ---$$



Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.115	0.616	0.000	$0.731 \leq 1.000 \quad \odot$

For section J-J :

Use BH : 250 x 820 x 10 x 6 mm

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Control for Shear :

Try a : 600 Cm

h : 80.00 Cm

a / h : 7.50 \geq 1.00

k : 5.41

Cv : 0.401 \geq 0.80

Fv : 333.18 Kg/Cm2

fv : 240.67 Kg/Cm2 ☺

h / tw : 133.33 < 260 \therefore Middle stiffener is not required !

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Column type 1 :

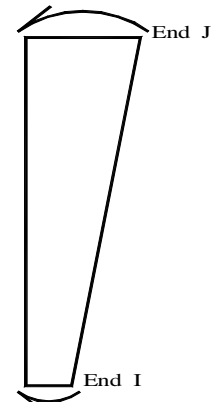
End I :		
P	4.180	Ton
V	2.000	Ton
M _x	0.000	T.m
M _y	0.000	T.m

End J :		
P	4.180	Ton
V	2.000	Ton
M _x	0.000	T.m
M _y	0.000	T.m

F_y : 2400 Kg/Cm2

E_s : 2.03E+06 Kg/Cm2

f : 2.00 m
h : 7.30 m
L : 20.00 m



Section I-I		
bf	200	mm
tf	10	mm
d	200	mm
tw	6	mm

Basic Properties for Section I-I						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
52.00	4813.33	1333.69	437.58	133.37	9.62	5.06

bf/2tf : 10.000 ≤ 16.269 ☺

d/tw : 33.333 ≤ 336.707 ☺

Section J-J		
bf	200	mm
tf	10	mm
d	200	mm
tw	6	mm

Basic Properties for Section J-J						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
52.00	4813.33	1333.69	437.58	133.37	9.62	5.06

bf/2tf : 10.000 ≤ 16.269 ☺

d/tw : 33.333 ≤ 336.707 ☺

Control for section I-I :

f / h : 0.274 & L / h : 2.740 ∴ K_x : 1.000 L_{ux} : 730 Cm
K_y : 1.000 L_{uy} : 730 Cm

K.L/r_x : 75.875

K.L/r_y : 144.14

C_c : 129.21 ∴ C_c ≤ (K.L/r)_{max} ∴ Fa : 503.102 Kg/Cm2

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f_a : 80.38 Kg/Cm2 ☺

f_a/F_a : 0.160 > 0.15 ∴ F'_{ex} : 1815.7 Kg/Cm2

C_{mx} : 0.85 F'_{ey} : 503.1 Kg/Cm2

$|M_{1y}|$: ---

$|M_{2y}|$: --- T.m

C_{my} : 1 *Considering the effect of lateral loads !*

$b_f/2t_f$: 10.000 ≤ 11.125 ☺

d/t_w : 33.333 ≤ 95.812 ☺

L_{ux} : 730 > min (260.054 & 585.833) ☹ ∴ *The section is non-compact !*

h_t : 3.333 Cm $|M_{1x}|$: ---

A_t : 22.000 Cm2 $|M_{2x}|$: --- T.m

I_{yy} : 666.673 Cm4 C_b : 1.000

r_t : 5.505 Cm

λ_t : 132.61

λ_B : 54.658

λ_C : 122.22 ∴ $\lambda > \lambda_C$ ∴ F_{b1} : 679.54 Kg/Cm2

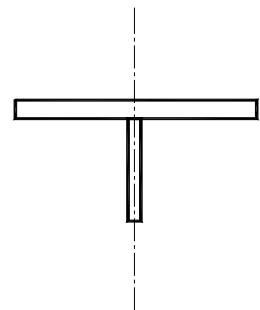
F_{b2} : 1050.56 Kg/Cm2

F_{bx} : 1050.56 Kg/Cm2

F_{by} : 1440.00 Kg/Cm2

f_{bx} : ---

f_{by} : ---



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Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	0.160	0.000	0.000	$0.16 \leq 1.000$ ☺
$f_a/F_a > 0.15$	0.056	0.000	0.000	$0.056 \leq 1.000$ ☺
$f_a/F_a \leq 0.15$	---	---	---	---

For section I-I :

Use BH : 200 x 220 x 10 x 6 mm

Control for section J-J :

$f/h : 0.274$ & $L/h : 2.740$ \therefore $K_x : 1.000$ $L_{ux} : 730$ Cm
 $K_y : 1.000$ $L_{uy} : 730$ Cm

$K.L/r_x : 75.875$

$K.L/r_y : 144.14$

$C_c : 129.21$ \therefore $C_c \leq (K.L/r)_{max}$ \therefore $F_a : 503.102$ Kg/Cm²

$f_a : 80.38$ Kg/Cm² ☺

$f_a/F_a : 0.160 > 0.15$ \therefore $F'_{ex} : 1815.7$ Kg/Cm²

$C_{mx} : 0.85$ $F'_{ey} : 503.1$ Kg/Cm²

$|M_{1y}| : ---$

$|M_{2y}| : ---$ T.m

$C_{my} : 1$ *Considering the effect of lateral loads !*

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$$b_f/2t_f : 10.000 \leq 11.125 \quad \text{☺}$$

$$d/t_w : 33.333 \leq 95.812 \quad \text{☺}$$

$$L_{ux} : 730 > \min (260.054 \quad \& \quad 585.833) \quad \text{☹} \therefore \text{The section is non-compact !}$$

$$h_t : 3.333 \text{ Cm} \quad | M_{1x} | : ---$$

$$A_t : 22.000 \text{ Cm}^2 \quad | M_{2x} | : --- \text{ T.m}$$

$$I_{yy} : 666.673 \text{ Cm}^4 \quad C_b : 1.000$$

$$r_t : 5.505 \text{ Cm}$$

$$\lambda_t : 132.61$$

$$\lambda_B : 54.658$$

$$\lambda_C : 122.22 \quad \therefore \lambda > \lambda_C \quad \therefore F_{b1} : 679.54 \text{ Kg/Cm}^2$$

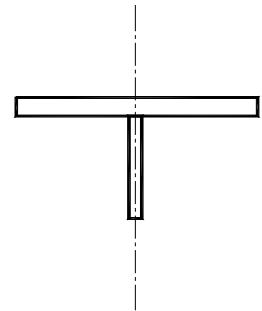
$$F_{b2} : 1050.56 \text{ Kg/Cm}^2$$

$$F_{bx} : 1050.56 \text{ Kg/Cm}^2$$

$$F_{by} : 1440.00 \text{ Kg/Cm}^2$$

$$f_{bx} : ---$$

$$f_{by} : ---$$



Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	0.160	0.000	0.000	$0.16 \leq 1.000 \quad \text{☺}$
$f_a/F_a > 0.15$	0.056	0.000	0.000	$0.056 \leq 1.000 \quad \text{☺}$
$f_a/F_a \leq 0.15$	---	---	---	---

For section J-J :

Use BH : 200 x 220 x 10 x 6 mm

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Control for Shear :

Try a : 600 Cm

h : 20.00 Cm

a / h : 30.00 \geq 1.00

k : 5.34

Cv : 2.255 \geq 0.80

Fv : 960 Kg/Cm2

fv : 166.67 Kg/Cm2 ☺

h / tw : 33.33 < 260 \therefore Middle stiffener is not required !

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Column type 2 :

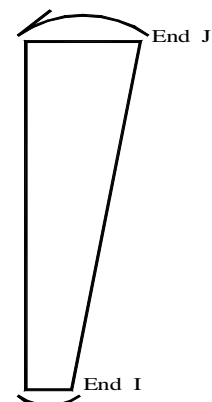
End I :		
P	8.400	Ton
V	3.610	Ton
M _x	0.000	T.m
M _y	0.000	T.m

End J :		
P	8.400	Ton
V	3.610	Ton
M _x	21.350	T.m
M _y	0.000	T.m

F_y : 2400 Kg/Cm2

E_s : 2.03E+06 Kg/Cm2

f :	2.00	m
h :	6.00	m
L :	20.00	m



Section I-I		
bf	250	mm
tf	10	mm
d	250	mm
tw	6	mm

Basic Properties for Section I-I						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
65.00	9235.42	2604.62	684.10	208.37	11.92	6.33

bf/2tf : 12.500 ≤ 16.269 ☺

d/tw : 41.667 ≤ 342.316 ☺

Section J-J		
bf	250	mm
tf	10	mm
d	800	mm
tw	6	mm

Basic Properties for Section J-J						
A Cm2	I _{xx} Cm4	I _{yy} Cm4	S _{xx} Cm3	S _{yy} Cm3	r _{xx} Cm	r _{yy} Cm
98.00	107616.67	2605.61	2624.80	208.45	33.14	5.16

bf/2tf : 12.500 ≤ 16.269 ☺

d/tw : 133.333 ≤ 342.316 ☺

Control for section I-I :

f / h : 0.333 & L / h : 3.333 ∴ K_x : 2.450 L_{ux} : 600 Cm
K_y : 1.000 L_{uy} : 600 Cm

K.L/r_x : 123.32

K.L/r_y : 94.784

C_c : 129.21 ∴ C_c > (K.L/r)_{max} ∴ F_s : 1.916
F_a : 682.14 Kg/Cm2

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f_a : 129.23 Kg/Cm2 ☺

f_a/F_a : 0.189 > 0.15 ∴ F'_{ex} : 687.32 Kg/Cm2

C_{mx} : 0.85 F'_{ey} : 1163.5 Kg/Cm2

$|M_{1y}|$: ---

$|M_{2y}|$: --- T.m

C_{my} : 1 *Considering the effect of lateral loads !*

$b_f/2t_f$: 12.500 > 11.125 ☹

d/t_w : 41.667 ≤ 87.475 ☺

L_{ux} : 600 > min (325.068 & 585.833) ☹ ∴ *The section is non-compact !*

h_t : 4.167 Cm $|M_{1x}|$: ---

A_t : 27.500 Cm2 $|M_{2x}|$: 21.350 T.m

I_{yy} : 1302.091 Cm4 C_b : 1.000

r_t : 6.881 Cm

λ_t : 87.196

λ_B : 54.658

λ_C : 122.22 ∴ $\lambda_B \leq \lambda \leq \lambda_C$ ∴ F_{b1} : 1192.80 Kg/Cm2

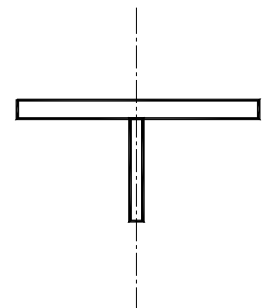
F_{b2} : 1301.85 Kg/Cm2

F_{bx} : 1301.85 Kg/Cm2

F_{by} : 1440.00 Kg/Cm2

f_{bx} : ---

f_{by} : ---



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Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	0.189	0.000	0.000	$0.189 \leq 1.000$ ☺
$f_a/F_a > 0.15$	0.090	0.000	0.000	$0.09 \leq 1.000$ ☺
$f_a/F_a \leq 0.15$	---	---	---	---

For section I-I :

Use BH : 250 x 270 x 10 x 6 mm

Control for section J-J :

$f/h : 0.333$ & $L/h : 3.333$ ∴ $K_x : 2.450$ $L_{ux} : 600$ Cm
 $K_y : 1.000$ $L_{uy} : 600$ Cm

$K.L/r_x : 44.36$

$K.L/r_y : 116.36$

$C_c : 129.21$ ∴ $C_c > (K.L/r)_{max}$ ∴ $F_s : 1.913$
 $F_a : 745.83$ Kg/Cm²

$f_a : 85.71$ Kg/Cm² ☺

$f_a/F_a : 0.115 \leq 0.15$

$C_{mx} : ---$

$|M_{1y}| : ---$

$|M_{2y}| : ---$

$C_{my} :$

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$b_f/2t_f : 12.500 > 11.125 \quad \ominus$

$d/t_w : 133.333 > 87.475 \quad \ominus$

$L_{ux} : 600 > \min (325.068 \quad \& \quad 183.073) \quad \ominus \therefore \text{The section is non-compact !}$

$h_t : 13.333 \text{ Cm} \quad | M_{1x} | : ---$

$A_t : 33.000 \text{ Cm}^2 \quad | M_{2x} | : 21.350 \text{ T.m}$

$I_{yy} : 1302.107 \text{ Cm}^4 \quad C_b : 1.000$

$r_t : 6.282 \text{ Cm}$

$\lambda_t : 95.518$

$\lambda_B : 54.658$

$\lambda_C : 122.22 \quad \therefore \quad \lambda_B \leq \lambda \leq \lambda_C \quad \therefore \quad F_{b1} : 1111.37 \text{ Kg/Cm}^2$

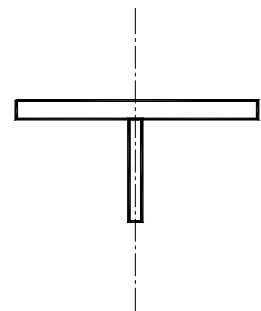
$F_{b2} : 428.66 \text{ Kg/Cm}^2$

$F_{bx} : 1111.37 \text{ Kg/Cm}^2$

$F_{by} : 1440.00 \text{ Kg/Cm}^2$

$f_{bx} : 813.4 \text{ Kg/Cm}^2$

$f_{by} : ---$



Description	Axial Stress	Bending X Stress	Bending Y Stress	Ratio
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a > 0.15$	---	---	---	---
$f_a/F_a \leq 0.15$	0.115	0.732	0.000	$0.847 \leq 1.000 \quad \odot$

For section J-J :

Use BH : 250 x 820 x 10 x 6 mm

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Control for Shear :

Try a : 600 Cm

h : 80.00 Cm

a / h : 7.50 \geq 1.00

k : 5.41

Cv : 0.401 \geq 0.80

Fv : 333.18 Kg/Cm2

fv : 240.67 Kg/Cm2 ☺

h / tw : 133.33 < 260 \therefore Middle stiffener is not required !