ANNÉE STRUCTURAL ENGINEERING, LLC

Structural Calculations

(Response to Review Corrections)

Project:

Mounger Residence

4006 E. Mercer Way
Mercer Island, WA 98040

For:

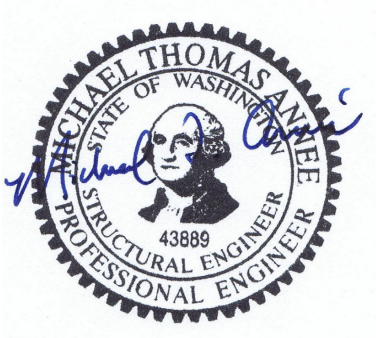
Sturman Architects
9 - 103rd Ave SE, Suite 203
Bellevue, WA 98004

By:

Année Structural Engineering, LLC
1801 18th Ave S
Seattle, WA 98144

Date:

July 21, 2022



Design Criteria

Project Name: Mounger Residence
Location: 4006 E. Mercer Way, Mercer Island

Date: 7/21/2022
Soil Bearing: 2000 psf
Frost Depth: 12"

ANNÉE STRUCTURAL ENGINEERING, LLC

Dead Loads:	Roof:			Floors:			Walls:	
	Comp. Roofing	5.1	PSF	Flooring	2.5	PSF	Siding	2.3 PSF
	1/2" Sheathing	1.7	PSF		0.0	PSF	Plywood	1.7 PSF
	Trusses	3.0	PSF	1-1/8" Subfloor	2.7	PSF	2x Studs	1.8 PSF
	Insulation	0.9	PSF	I-Joists	2.5	PSF	Insulation	0.5 PSF
	5/8" Gypsum	2.8	PSF	5/8" Gypsum	2.8	PSF	1/2" Gypsum	2.2 PSF
	Miscellaneous	3.5	PSF	Miscellaneous	1.5	PSF	Miscellaneous	1.5 PSF
	Total	**17.0**	**PSF**	Total	**12.0**	**PSF**	Total	**10.0 PSF**
Live Loads:	Snow	**25.0**	**PSF**	Floor	**40.0**	**PSF**	*Wind*	*18.0 PSF*

Seismic Loads: *per 2018 IBC, Sect. 1613 & ASCE 7-16, Chapter 11*

Design Category = D Importance = 1.0 Redundancy = 1.00
Site Class = D R = 6.5
Latitude (°N) = 47.574 *(per USGS)* S_s = 1.402 F_a = 1.00 $S_{DS} = 2/3(F_a x S_s)$ = 0.935
Longitude (°W) = 122.205 *(per USGS)* S_1 = 0.487 F_v = 1.81 $S_{D1} = 2/3(F_v x S_1)$ = 0.589

Building Height: C_t = 0.02 (wood); h_n = 23.3 ft.
Period: $T=C_t(h_n)^{3/4}$ = 0.21 sec. $T_0=0.2*(S_{D1}/S_{DS})$ = 0.13 $T_S=(S_{D1}/S_{DS})$ = 0.63

S_a = 0.935 $S_a=S_{DS}$ if $T_0<T<T_s$, $S_a=0.6*(S_{DS}/T_0)*T+0.4*S_{DS}$ if $T<T_0$, $S_a=S_{D1}/T$ if $T>T_s$

Not greater than:	$C_s=S_{D1}/T*(R/I)$ =	0.427
Not less than:	$C_s=0.044S_{DS}*I$ =	0.041
Design Category E or F; not less than:	$C_s=0.5S_1/(R/I)$ =	0.037
Seismic Design Coefficient:	$C_s=S_{DS}/(R/I)$ =	0.144
	C_s =	**0.144**

Seismic Weight Distrubution:

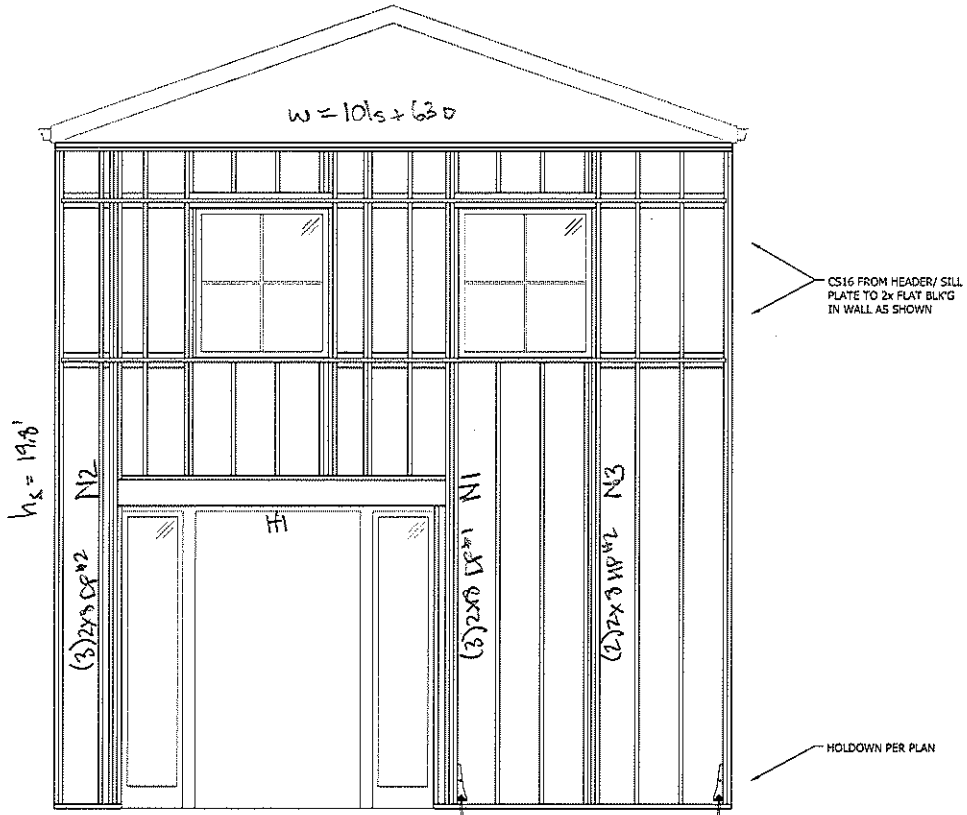
Diaphragm	h_i (ft.)	w_i (kips)	$h_i w_i$ (K-ft.)	$w_i h_i/sum(w_i h_i)$	**F_i (lbs.)**	Sum F_i (lbs.)
			0	0	**0**	0
			0	0	**0**	0
			0	0	**0**	0
Roof	21.8	71.26	1556	0.4814	**10,069**	10,069
2nd Floor	12.3	136.5	1676	0.5186	**10,845**	20,914
		207.77	3233			

Design Base Shear (working str.) = 0.7*(0.144 * W) = 0.101 * W = **20,914 lbs.**

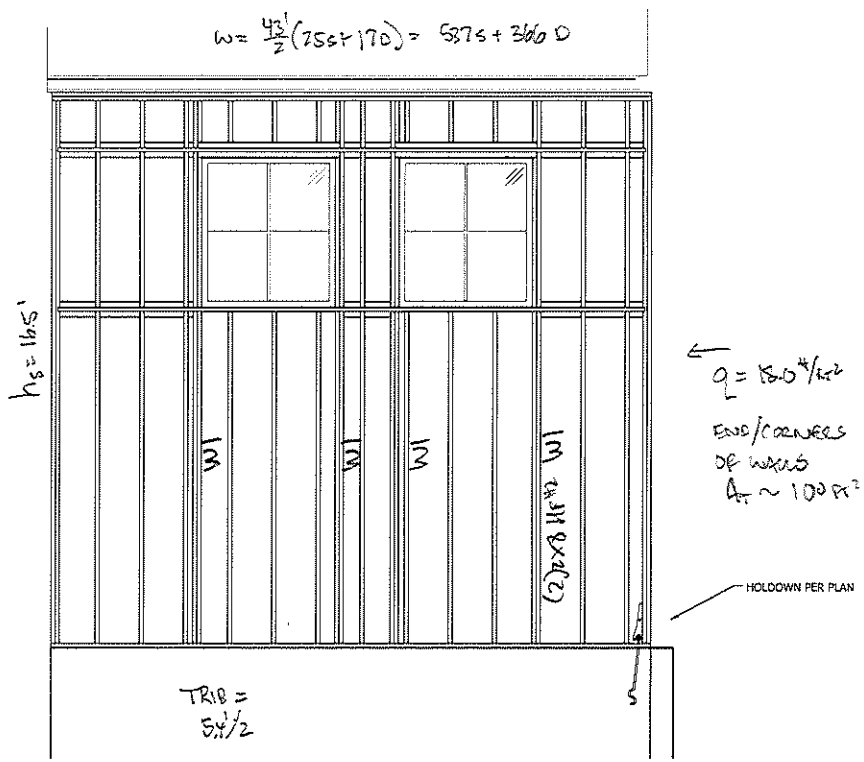
Wind Loads: *per ASCE 7-16, Section 27.5* *Section 30.4* Cladding (ft2): 100 20

		Zone		(ASD) **Adj.**
Wind Speed (MPH)	110	Zone		**Adj.**
Exposure	C	Wall - Ph	27.0	**16.2**
Roof Pitch (x:12)	5	Wall - Po	26.2	**15.7**
K_1=	0.00	Roof - 1	9.7	**5.8**
K_2=	0.00	Roof - 2	-8.0	**-4.8**
K_3=	0.00	Roof - 3	-27.4	**-16.4**
$K_t=(1+K_1*K_2*K_3)^2$=	1.00	Roof - 4	-24.4	**-14.6**
(p.362) λ =	1.33	Roof - 5	-20.0	**-12.0**
(p.291) Exp. Fctr =	1.00			

	Zone	Pn30	(ASD) P	Pn30	(ASD) P
(p.352) Wall	4	-20.4	-16.2	-22.6	**-18.0**
	5	-22.6	-18.0	-27.2	**-21.6**
Roof	1	-22.8	**-18.1**	-31.0	-24.7
	2e	-22.8	**-18.1**	-31.0	-24.7
	2n	-29.0	**-23.1**	-43.3	-34.5
	2r	-29.0	**-23.1**	-43.3	-34.5
	3e	-29.0	**-23.1**	-43.3	-34.5
	3r	-36.5	**-29.0**	-52.0	-41.4



10 North Entry Wall Elevation
3/8" = 1'-0"



12 West Entry Wall Elevation
3/8" = 1'-0"

HEADER (H1): L = 9.6'; w = 11'(100) + 10ls + 63D
= 274#/ft.

R = V = 1,315#; M = 3,156 ft-#

f_v = 59 psi; f_b = 713 psi; Δ_{TL} = 0.13" = L/880

OUT-OF-PLANE: $w = \frac{19.8'}{2}(15.0) = 178$#/ft.

R = V = 855#; M = 2,053 ft-#

f_v = 39 psi; f_b = 1,270 psi; Δ_w = 0.44" = L/263

∴ 4x10 DF#2 OK

PROJECT: Mounger Residence
MEMBER: North wall mullion - N1

DATE: 07/21/22
BY: MTA

NDS 2018 Column Design *- Combined Bending and Axial Load*

Section	Grade
A	#2 SPF
B	#1 DF
C	#2 DF
D	#1 HF
E	#2 HF
F	HF-STUD
G	1.8E PSL

Stud Spacing	86
Wind (psf)	18.0
Moment (ft.-lbs.)	6,351
Moment - Strong	0
Moment - Weak	0
Axial Load (plf)	164
Load/stud (lbs.)	1,181
Ke	1.0

# of members	3
Section Mark	**2x8**
Grade Mark	B
Axial Load (lbs.)	1,181
Moment Strong Axis (ft.-lbs.)	6,470
Moment Weak Axis (ft.-lbs.)	0
Load Duration Factor	1.60
Repetitive Factor Cr	1.15
Incised Lumber (Y/N)	N
Unbraced Length Strong Axis (ft.)	19.80
Unbraced Length Weak Axis (ft.)	1.33
Grade	**#1 DF**
Axial alone = fc/F'c	**0.08**
Interaction Eq. Term 1	0.01
Interaction Eq. Term 2	0.97
Interaction Eq. Term 3	0.00
Total Interaction Eq.	**0.97**

Mk	Section
A	2x4
B	2x6
C	2x8
D	2x10
E	2x12
F	4x4
G	4x6
H	4x8
I	4x10
J	4x12
K	6x6
L	6x8
M	6x10
N	6x12
P	5-1/4x7
3	**2x8**

Strong axis deflection - uniform load over simple span of 19.8' =	**1.32**	**L / 181**
Weak axis deflection - uniform load over simple span of 1.33' =	0.00	L / 0
Strong axis deflection - point load at center of 19.8' span =	1.05	L / 226
Weak axis deflection - point load at center of 1.33' span =	0.00	L / 0

Fbx (psi) = 1,200
Fby (psi) = 1,380
Fc (psi) = 1,575
Ex (psi) = 1.70E+06
Ex min (psi) = 6.20E+05
Ey (psi) = 1.70E+06
Ey min (psi) = 6.20E+05

fc = P/A (psi) =	36.2	AXIAL
F*c = Fc x Cd x Ci(psi) =	2520.0	
K*(le2/d2) =	3.5	**OK**
K*(le1/d1) =	32.8	**OK**
=	474.5	
F' = Fce/F*c =	0.188	
c =	0.8	
(1+F')/2c =	0.743	
Cp =	0.180	Column Stability Factor
F'c = F*c x Cp (psi) =	454.5	
fc/F'c =	**0.080**	
(fc/F'c)^2 =	**0.01**	Interaction Equation, 1st term

fb1 = M/S (psi) =	1969.4	STRONG AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	2208.0	
lu =	16.0	in.
le =	32.9	in.
Rb = sq. rt.(le x d/b^2)	4.4	**OK**
Fbe = 1.2 x E'min/Rb^2 (psi) =	39002.8	**OK**
F = Fbe/Fb* =	17.664	
(1+F)/1.9 =	9.823	
CL =	0.997	Beam Stability Factor
F'b1 (psi) =	2201.4	
fb1/F'b1 =	**0.895**	
(psi) =	474.5	**OK**
1-(fc/Fce1) =	0.924	
fb1/[F'b1*(1-(fc/Fce2))] =	**0.97**	Interaction Equation, 2nd term

fb2 = M/S (psi) =	0.0	WEAK AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	2539.2	
Fbe = 1.2 x E'min/Rb^2 (psi) =	39002.8	**OK**
F = Fbe/Fb* =	15.360	
(1+F)/1.9 =	8.611	
CL =	0.997	Beam Stability factor
F'b2 (psi) =	2530.4	
fb2/F'b2 =	**0.000**	
(psi) =	40515.6	**OK**
1-(fc/Fce2) =	0.999	
fb1/Fbe =	0.050	
fb2/[(F'b2)*(1-(fc/Fce2)-(fb1/Fbe)^2)] =	**0.00**	Interaction Equation, 3rd term

PROJECT: Mounger Residence
MEMBER: North wall mullion - N2

DATE: 07/21/22
BY: MTA

NDS 2018 Column Design *- Combined Bending and Axial Load*

Section	Grade
A	#2 SPF
B	#1 DF
C	#2 DF
D	#1 HF
E	#2 HF
F	HF-STUD
G	1.8E PSL

Stud Spacing	70
Wind (psf)	18.0
Moment (ft.-lbs.)	5,160
Moment - Strong	0
Moment - Weak	0
Axial Load (plf)	164
Load/stud (lbs.)	959
Ke	1.0

# of members	3
Section Mark	**2x8**
Grade Mark	C
Axial Load (lbs.)	959
Moment Strong Axis (ft.-lbs.)	5,257
Moment Weak Axis (ft.-lbs.)	0
Load Duration Factor	1.60
Repetitive Factor Cr	1.15
Incised Lumber (Y/N)	N
Unbraced Length Strong Axis (ft.)	19.80
Unbraced Length Weak Axis (ft.)	1.33
Grade	**#2 DF**
Axial alone = fc/F'c	**0.07**
Interaction Eq. Term 1	0.00
Interaction Eq. Term 2	0.86
Interaction Eq. Term 3	0.00
Total Interaction Eq.	**0.87**

Mk	Section
A	2x4
B	2x6
C	2x8
D	2x10
E	2x12
F	4x4
G	4x6
H	4x8
I	4x10
J	4x12
K	6x6
L	6x8
M	6x10
N	6x12
P	5-1/4x7
3	**2x8**

Strong axis deflection - uniform load over simple span of 19.8' =	**1.14**	**L / 209**
Weak axis deflection - uniform load over simple span of 1.33' =	0.00	L / 0
Strong axis deflection - point load at center of 19.8' span =	0.91	L / 262
Weak axis deflection - point load at center of 1.33' span =	0.00	L / 0

Fbx (psi) = 1,080
Fby (psi) = 1,242
Fc (psi) = 1,575
Ex (psi) = 1.60E+06
Ex min (psi) = 5.80E+05
Ey (psi) = 1.60E+06
Ey min (psi) = 5.80E+05

fc = P/A (psi) =	29.4	AXIAL
F*c = Fc x Cd x Ci(psi) =	2520.0	
K*(le2/d2) =	3.5	**OK**
K*(le1/d1) =	32.8	**OK**
=	443.9	
F' = Fce/F*c =	0.176	
c =	0.8	
(1+F')/2c =	0.735	
Cp =	0.169	Column Stability Factor
F'c = F*c x Cp (psi) =	426.5	
fc/F'c =	**0.069**	
(fc/F'c)^2 =	**0.00**	Interaction Equation, 1st term

fb1 = M/S (psi) =	1600.2	STRONG AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	1987.2	
lu =	16.0	in.
le =	32.9	in.
Rb = sq. rt.(le x d/b^2)	4.4	**OK**
Fbe = 1.2 x E'min/Rb^2 (psi) =	36486.5	**OK**
F = Fbe/Fb* =	18.361	
(1+F)/1.9 =	10.190	
CL =	0.997	Beam Stability Factor
F'b1 (psi) =	1981.5	
fb1/F'b1 =	**0.808**	
(psi) =	443.9	**OK**
1-(fc/Fce1) =	0.934	
fb1/[F'b1*(1-(fc/Fce2))] =	**0.86**	Interaction Equation, 2nd term

fb2 = M/S (psi) =	0.0	WEAK AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	2285.3	
Fbe = 1.2 x E'min/Rb^2 (psi) =	36486.5	**OK**
F = Fbe/Fb* =	15.966	
(1+F)/1.9 =	8.929	
CL =	0.997	Beam Stability factor
F'b2 (psi) =	2277.7	
fb2/F'b2 =	**0.000**	
(psi) =	37901.7	**OK**
1-(fc/Fce2) =	0.999	
fb1/Fbe =	0.044	
fb2/[(F'b2)*(1-(fc/Fce2)-(fb1/Fbe)^2)] =	**0.00**	Interaction Equation, 3rd term

PROJECT: **Mounger Residence** **DATE:** 07/21/22
MEMBER: **North wall mullion - N3** **BY:** **MTA**

NDS 2018 Column Design *- Combined Bending and Axial Load*

Section	Grade
A	#2 SPF
B	#1 DF
C	#2 DF
D	#1 HF
E	#2 HF
F	HF-STUD
G	1.8E PSL

Stud Spacing	32
Wind (psf)	18.0
Moment (ft.-lbs.)	2,382
Moment - Strong	0
Moment - Weak	0
Axial Load (plf)	164
Load/stud (lbs.)	443
Ke	1.0

# of members	2
Section Mark	**2x8**
Grade Mark	E
Axial Load (lbs.)	443
Moment Strong Axis (ft.-lbs.)	2,426
Moment Weak Axis (ft.-lbs.)	0
Load Duration Factor	1.60
Repetitive Factor Cr	1
Incised Lumber (Y/N)	N
Unbraced Length Strong Axis (ft.)	19.80
Unbraced Length Weak Axis (ft.)	1.33
Grade	**#2 HF**
Axial alone = fc/F'c	**0.06**
Interaction Eq. Term 1	0.00
Interaction Eq. Term 2	0.72
Interaction Eq. Term 3	0.00
Total Interaction Eq.	**0.73**

Mk	Section
A	2x4
B	2x6
C	2x8
D	2x10
E	2x12
F	4x4
G	4x6
H	4x8
I	4x10
J	4x12
K	6x6
L	6x8
M	6x10
N	6x12
P	5-1/4x7
2	**2x8**

Strong axis deflection - uniform load over simple span of 19.8' =	**0.97**	**L / 246**
Weak axis deflection - uniform load over simple span of 1.33' =	0.00	L / 0
Strong axis deflection - point load at center of 19.8' span =	0.77	L / 307
Weak axis deflection - point load at center of 1.33' span =	0.00	L / 0

Fbx (psi) = 1,020
Fby (psi) = 1,173
Fc (psi) = 1,575
Ex (psi) = 1.30E+06
Ex min (psi) = 4.70E+05
Ey (psi) = 1.30E+06
Ey min (psi) = 4.70E+05

fc = P/A (psi) =	20.4	AXIAL
F*c = Fc x Cd x Ci(psi) =	2520.0	
K*(le2/d2) =	5.3	**OK**
K*(le1/d1) =	32.8	**OK**
=	359.7	
F' = Fce/F*c =	0.143	
c =	0.8	
(1+F')/2c =	0.714	
Cp =	0.138	Column Stability Factor
F'c = F*c x Cp (psi) =	348.5	
fc/F'c =	**0.058**	
(fc/F'c)^2 =	**0.00**	Interaction Equation, 1st term

fb1 = M/S (psi) =	1107.8	STRONG AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	1632.0	
lu =	16.0	in.
le =	32.9	in.
Rb = sq. rt.(le x d/b^2)	6.6	**OK**
Fbe = 1.2 x E'min/Rb^2 (psi) =	13140.7	**OK**
F = Fbe/Fb* =	8.052	
(1+F)/1.9 =	4.764	
CL =	0.993	Beam Stability Factor
F'b1 (psi) =	1620.6	
fb1/F'b1 =	**0.684**	
(psi) =	359.7	**OK**
1-(fc/Fce1) =	0.943	
fb1/[F'b1*(1-(fc/Fce2))] =	**0.72**	Interaction Equation, 2nd term

fb2 = M/S (psi) =	0.0	WEAK AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	1876.8	
Fbe = 1.2 x E'min/Rb^2 (psi) =	13140.7	**OK**
F = Fbe/Fb* =	7.002	
(1+F)/1.9 =	4.211	
CL =	0.992	Beam Stability factor
F'b2 (psi) =	1861.4	
fb2/F'b2 =	**0.000**	
(psi) =	13650.4	**OK**
1-(fc/Fce2) =	0.999	
fb1/Fbe =	0.084	
fb2/[(F'b2)*(1-(fc/Fce2)-(fb1/Fbe)^2)] =	**0.00**	Interaction Equation, 3rd term

PROJECT: **Mounger Residence** **DATE:** 07/21/22
MEMBER: **West wall mullion - W1** **BY:** **MTA**

NDS 2018 Column Design *- Combined Bending and Axial Load*

Section	Grade
A	#2 SPF
B	#1 DF
C	#2 DF
D	#1 HF
E	#2 HF
F	HF-STUD
G	1.8E PSL

Stud Spacing	32
Wind (psf)	18.0
Moment (ft.-lbs.)	1,654
Moment - Strong	0
Moment - Weak	0
Axial Load (plf)	903
Load/stud (lbs.)	2,438
Ke	1.0

# of members	2
Section Mark	**2x8**
Grade Mark	E
Axial Load (lbs.)	2,438
Moment Strong Axis (ft.-lbs.)	1,899
Moment Weak Axis (ft.-lbs.)	0
Load Duration Factor	1.60
Repetitive Factor Cr	1.15
Incised Lumber (Y/N)	N
Unbraced Length Strong Axis (ft.)	16.50
Unbraced Length Weak Axis (ft.)	1.33
Grade	**#2 HF**
Axial alone = fc/F'c	**0.23**
Interaction Eq. Term 1	0.05
Interaction Eq. Term 2	0.59
Interaction Eq. Term 3	0.00
Total Interaction Eq.	**0.65**

Mk	Section
A	2x4
B	2x6
C	2x8
D	2x10
E	2x12
F	4x4
G	4x6
H	4x8
I	4x10
J	4x12
K	6x6
L	6x8
M	6x10
N	6x12
P	5-1/4x7
2	**2x8**

Strong axis deflection - uniform load over simple span of 16.5' =	**0.53**	**L / 376**
Weak axis deflection - uniform load over simple span of 1.33' =	0.00	L / 0
Strong axis deflection - point load at center of 16.5' span =	0.42	L / 470
Weak axis deflection - point load at center of 1.33' span =	0.00	L / 0

Fbx (psi) =	1,020
Fby (psi) =	1,173
Fc (psi) =	1,575
Ex (psi) =	1.30E+06
Ex min (psi) =	4.70E+05
Ey (psi) =	1.30E+06
Ey min (psi) =	4.70E+05

fc = P/A (psi) =	112.1	AXIAL
F*c = Fc x Cd x Ci(psi) =	2520.0	
K*(le2/d2) =	5.3	**OK**
K*(le1/d1) =	27.3	**OK**
=	518.0	
F' = Fce/F*c =	0.206	
c =	0.8	
(1+F')/2c =	0.753	
Cp =	0.196	Column Stability Factor
F'c = F*c x Cp (psi) =	493.9	
fc/F'c =	**0.227**	
(fc/F'c)^2 =	**0.05**	Interaction Equation, 1st term

fb1 = M/S (psi) =	867.3	STRONG AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	1876.8	
lu =	16.0	in.
le =	32.9	in.
Rb = sq. rt.(le x d/b^2)	6.6	**OK**
Fbe = 1.2 x E'min/Rb^2 (psi) =	13140.7	**OK**
F = Fbe/Fb* =	7.002	
(1+F)/1.9 =	4.211	
CL =	0.992	Beam Stability Factor
F'b1 (psi) =	1861.4	
fb1/F'b1 =	**0.466**	
(psi) =	518.0	**OK**
1-(fc/Fce1) =	0.784	
fb1/[F'b1*(1-(fc/Fce2))] =	**0.59**	Interaction Equation, 2nd term

fb2 = M/S (psi) =	0.0	WEAK AXIS BENDING
Fb* = Fb x Cd x Cr x Ci (psi) =	2158.3	
Fbe = 1.2 x E'min/Rb^2 (psi) =	13140.7	**OK**
F = Fbe/Fb* =	6.088	
(1+F)/1.9 =	3.731	
CL =	0.990	Beam Stability factor
F'b2 (psi) =	2137.6	
fb2/F'b2 =	**0.000**	
(psi) =	13650.4	**OK**
1-(fc/Fce2) =	0.992	
fb1/Fbe =	0.066	
fb2/[(F'b2)*(1-(fc/Fce2)-(fb1/Fbe)^2)] =	**0.00**	Interaction Equation, 3rd term