Lee's Summit Medical Center, Hybrid OR

Lee's Summit, Missouri

Structural Calculations

Prepared for:
ACI Boland Architects
Kansas City, Missouri

PEC Project No.:
190711-000

STATE OF MISSOURI
DANIEL L.
WETHINGTON
NUMBER
E-1999137726
03-25-2020
REGISTERED PROFESSIONAL ENGINEER

Prepared by:
Daniel L. Wethington, PE, SE
Structural Division

Date:
March 25, 2020

Project:

Lee’s Summit Medical Center Hybrid OR Addition
Lee’s Summit Missouri

Prepared for:

ACI-Boland Architects
Kansas City, Missouri

Structural Calculations – Table of Contents

Professional Engineering Consultants, P.A.
623 Massachusetts Stret, Suite 200
Lawrence, Kansas 66044

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Date: 12/19/2019
Engr: DLW

STRUCTURAL LOADS (Per 2018 International Building Code)

Lee's Summit Hybrid ER 190711-000

DEAD LOAD

Item	*unit wt. (psf)*
Roofing	5.00
Deck	1.00
Joist/rafter	3.00
Sprinkler	2.00
Ceiling	3.00
Collateral	6.00
Special	10.00
Total	30.00

LIVE LOAD

20 psf (non-reducible) *(Roof)*
0 psf *(Floor)*

GROUND SNOW

Pg (psf) =	20
exposure=	1
I =	1
Ct	1
Pf (psf) =	14
Pm (psf)=	20

See drift calculation spreadsheet

WIND LOAD (PER ASCE 7-10)

Wind Speed (mph) =	120
Exposure =	C
Gust Factor (G) =	0.85
Kz =	0.90
Kd =	0.85
Kzt =	1.00
Importance	N/A
Gcpi = +/-	0.18
"a" =	3.80

BUILDING PARAMETERS

Width (ft)=	58
Length (ft)=	38
Mean Roof height (ft)=	20 max.
L/W =	0.66
H/L =	0.53
H/W =	0.34
Roof slope	0 /12
Roof angle	0.00

Velocity Pressure qz (psf) = 28.20 Ultimate
Velocity Pressure qz (psf) = 16.92 Service

MAIN WIND FORCE RESISTING SYSTEM (Service)

p = q x (G x Cp - Gcpi)

	CGCpi= 0.18			Gcpi= -0.18		
	Cp	p (psf)		Cp	p (psf)	
Windward	0.8	8.46		0.8	14.55	
			18.70			18.70
Leeward	-0.5	-10.24	-or-	-0.5	-4.15	-or-
			18.70			18.70
Windward Roof	-0.9	-15.99		-0.9	-9.90	
Leeward Roof	-0.9	-15.99		-0.9	-9.90	

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WIND LOADS (CONT.)
COMPONENTS AND CLADDING (Service)

Location	GCp - max	p-max (psf)	GCp - min	p-min (psf)
Interior Roof	0.30	8.12	-1.00	-19.97
Rake/Eave	0.30	8.12	-1.80	-33.50
Roof Corner	0.30	8.12	-2.80	-50.42
Interior Wall	1.00	19.97	-1.10	-21.66
Wall Corner	1.00	19.97	-1.40	-26.73
Overhang	-1.1	-15.57	-2.8	-50.42

SEISMIC LOADS (Ultimate)

Site Class D (Assumed)

S_s = 0.101 F_a = 1.6 S_{DS} = 0.108
S_1 = 0.069 F_v = 2.4 S_{D1} = 0.110

Seismic Design Category =	B		
Seismic Use Group =	II	k =	1
Response Factor =	3	ρ =	1.00
Importance Factor =	1.50	Cd =	3
Fund. Period =	0.19	Ai (ft^2)=	2204
Overstrength =	3.00	C_t=	0.02
T_L	12.00	x=	0.75

C_s = 0.053867 controls

$C_{s\text{-}max}$ = 0.29183 Controlling Cs = 0.053867
V(ult.)= 10.18

$C_{s\text{-}min}$ = 0.00711

Calculate Seismic Weights

Level	weight	height	w*h^k	Fx (k)	Eh	Ev	Eh+Ev	Eh-Ev
Roof	189	20	66.12	10.18	10.18	4.07	14.25	6.11
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
x	0	0	0	0.00	0.00	0.00	0.00	0.00
Sums	189		66.12	10.18 (ult)	10.18 (ult)	4.07	14.25	6.11

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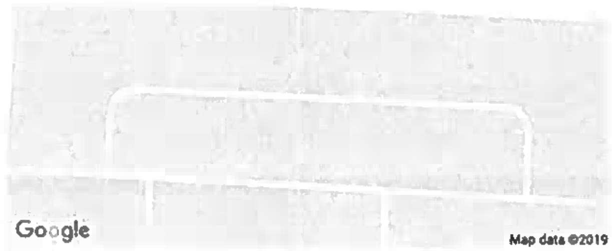
ATC Hazards by Location

Search Information

Coordinates:	38.9042, -94.3329
Elevation:	1002 ft
Timestamp:	2019-12-18T22:15:49.195Z
Hazard Type:	Wind



ASCE 7-16

MRI 10-Year	76 mph
MRI 25-Year	83 mph
MRI 50-Year	89 mph
MRI 100-Year	94 mph
Risk Category I	103 mph
Risk Category II	110 mph
Risk Category III	118 mph
Risk Category IV	122 mph

ASCE 7-10

MRI 10-Year	76 mph
MRI 25-Year	84 mph
MRI 50-Year	90 mph
MRI 100-Year	96 mph
Risk Category I	105 mph
Risk Category II	115 mph
Risk Category III-IV	120 mph

ASCE 7-05

ASCE 7-05 Wind Speed	90 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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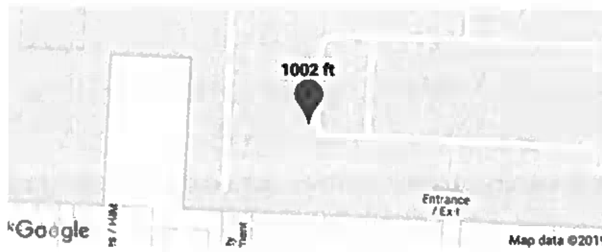
ATC Hazards by Location

Search Information

Coordinates:	38.9042, -94.3329
Elevation:	1002 ft
Timestamp:	2019-12-18T22:16:47.129Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	III
Site Class:	D



Basic Parameters

Name	Value	Description
S_S	0.101	MCE_R ground motion (period=0.2s)
S_1	0.069	MCE_R ground motion (period=1.0s)
S_{MS}	0.161	Site-modified spectral acceleration value
S_{M1}	0.165	Site-modified spectral acceleration value
S_{DS}	0.107	Numeric seismic design value at 0.2s SA
S_{D1}	0.11	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2s
F_v	2.4	Site amplification factor at 1.0s
CR_S	0.926	Coefficient of risk (0.2s)
CR_1	0.876	Coefficient of risk (1.0s)
PGA	0.048	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.076	Site modified peak ground acceleration
T_L	12	Long-period transition period (s)
SsRT	0.101	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.109	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.069	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.078	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

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Disclaimer

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ATC Hazards by Location

Search Information

Coordinates: 38.9042, -94.3329

Elevation: 1002 ft

Timestamp: 2019-12-18T22:16:20.131Z

Hazard Type: Snow

ASCE 7-16

Ground Snow Load .... 20 lb/sqft

ASCE 7-10

Ground Snow Load .... 20 lb/sqft

ASCE 7-05

Ground Snow Load .... 20 lb/sqft

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer.

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Spirit Aerosystems Clinic
Drift from parapet
SNOW DRIFT CALCULATION SPREADSHEET

Ground Snow Load, Pg (psf) =	15	
Exposure Factor, Ce =	1	
Snow importance Factor =	1	
Ct =	1	
Rain on Snow Load (psf) =	0	
Roof Snow Load,Pf (psf) =	10.50	
Density of Snow, D (pcf) =	15.95	ok
Basic Roof Snow Load, hb (ft)=	0.66	

High Building Width (ft) in dir. of wind (leeward drift) = 20 ok low bldg width (ft) = 100

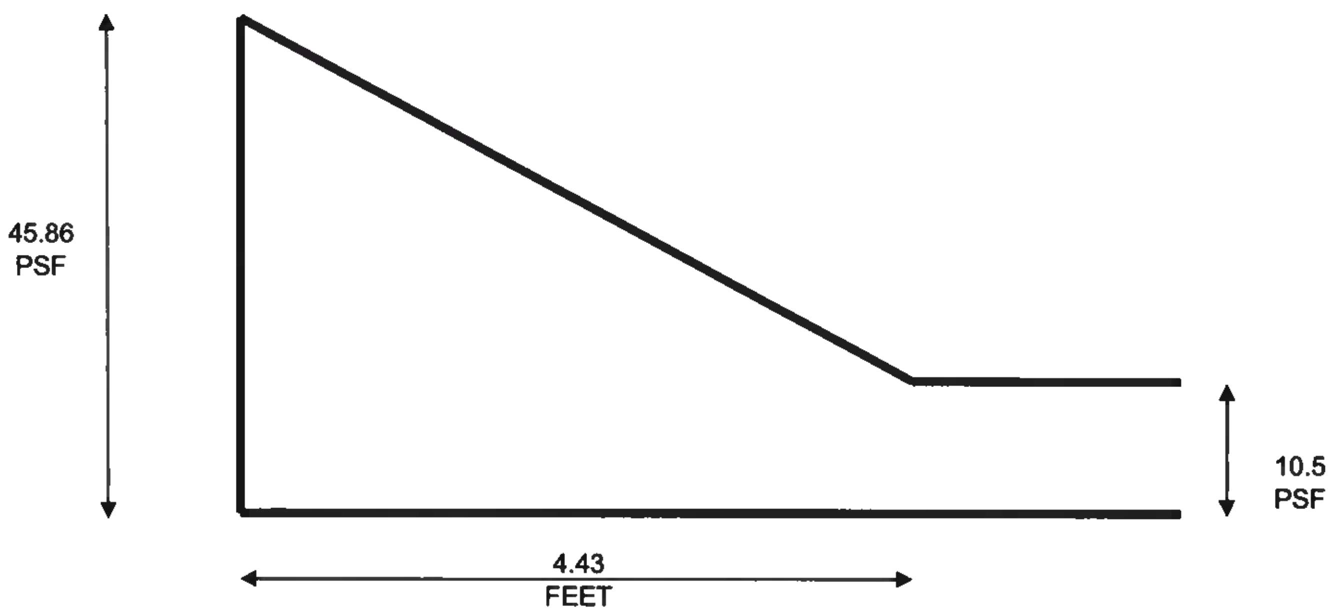
Height of Roof Step, hr (ft) = 4

	Leeward		Windward
Height of Drift, hd (ft) =	1.11		2.22
Controlling Drift Height (ft) =	2.22	ok	

Maximum Snow Drift Intensity, Pm (psf) 45.86

Drift Length, Wd (ft) 4.43 controls

OR 13.37



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PROFESSIONAL ENGINEERING CONSULTANTS PA
623 MASSACHUSETTS STREET, SUITE 200 | LAWRENCE, KANSAS 66044
785-842-6464 | www.pec1.com

Project LSMCHOR Date 12.18.19
Item LAT. LOADS By DW

WIND LOAD

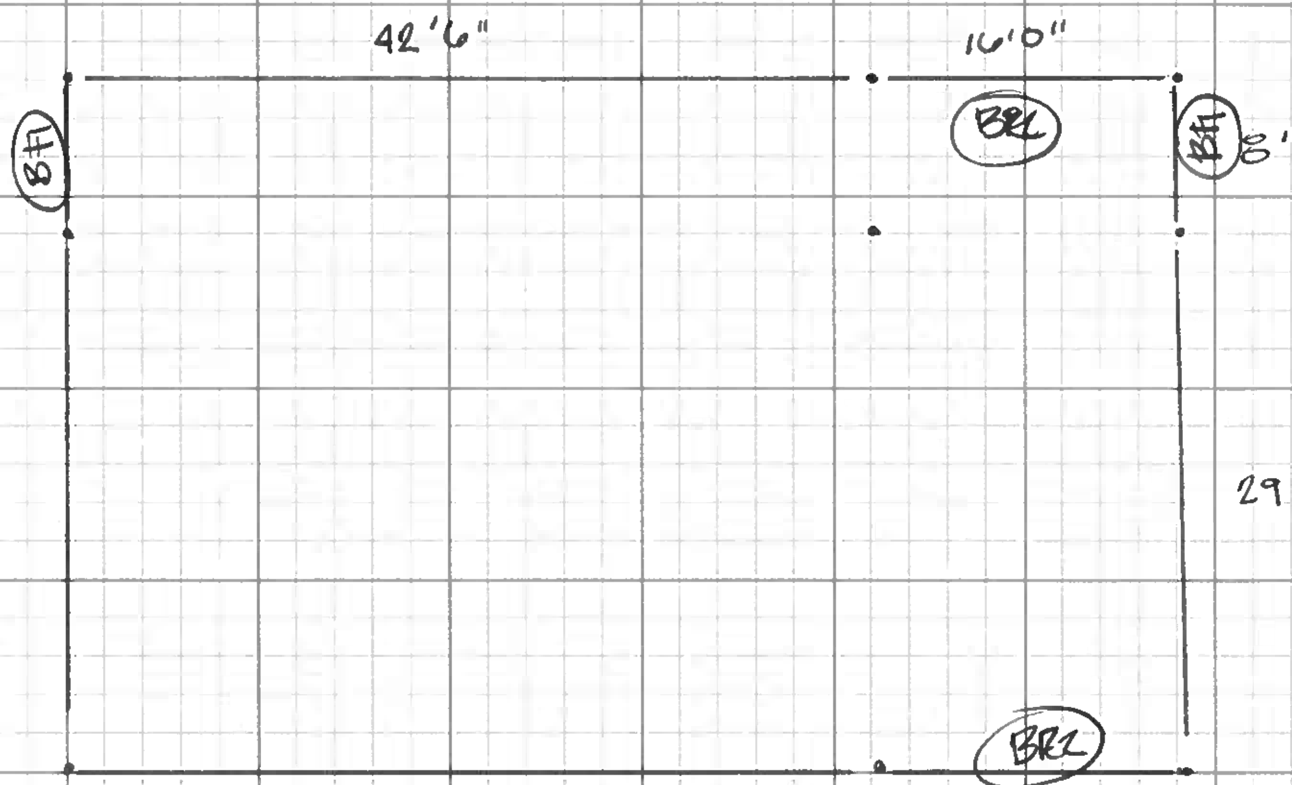
$h_{wall} = 16'$
$h_{parapet} = 2'8"$ ⟩ $w_{LAT} = 203.6$ lb/ft HOR

$L = 58'$ ⇒ $V = 203.6$ lb/ft $(58')/2 = 5.9K$
$W = 38'$ ⇒ $V = 203.6$ lb/ft $(38')/2 = 3.9K$

SEISMIC LOAD

$V = 10.2k(0.55) = 5.6k$

∴ WIND CONTROLS IN N-S DIRECTION @ 5.9K
EQ CONTROLS IN E-W DIRECTION @ 5.6K



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Project LSMCHOR Date 12.18.19

Item LAT DESIGN By DW

■ BF1.

$H = 16'$
$W = 8'$
$\phi = 63.43°$
$L = 17.9 ft$
$V = 5.9K$
$T = C = 13.2K$

REACTION = ±11.8K

USE HSS 4x4x¼

■ BF2

$H = 16'$
$W = 16'$
$\phi = 45°$
$L = 22.63'$
$V = 5.6K$
$T = C = 7.9K$

REACTION = ±5.6K

USE HSS 4x4x¼

■ ROOF DIAPHRAGM

$W_{max} = 5.9^k / 38' = 155.26$ lb/ft

USE 1½" x 22 ga.

ATTACH W/ ⅝"Ø PUDDLE WELDS

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LSMCHOR
BF1 Brace

Section	ts4x4x1/4				
P (kip)	13.2	t (in)	0.25	klx/rx	142.25
Mx(K*ft)	0.00	b/t	16.00	kly/ry	142.25
My (K*ft)	0.00	Sx(in^3)	4.11	Cc(ksi)	111.55
Lx(ft)	17.9	Sy(in^3)	4.11	F'ex(ksi)	7.38
Ly(ft)	17.9	A	3.59	F'ey(ksi)	7.38
Ltot(ft)	17.9	rx	1.51	Ix(in^4)=	8.22
Fy(ksi)	46	ry	1.51	Iy(in^4)=	8.22
bx(in)	4	kx	1.00	bx/t =	16.00
by(in)	4	ky	1.00	by/t =	16.00
		W/S Load (Y/N) =	N		

Find Axial Allowable Stress
Controlling Slenderness Ratio = 142.25 OK
kl/r / Cc= 1.28
Fa (ksi) = 7.38
fa(ksi)= 3.68
fa/Fa= 0.498

Find Allowable Bending Stresses

Is Section Compact?	yes		yes
Lcx (ft)	14.13	Lcy(ft)	14.13
Fbx (ksi)	27.6	Fby (ksi)	27.6
fbx (ksi)	0.00	fby (ksi)	0.00

Check Combined Stresses
Is fa/Fa > 0.15 YES

Unity Chk. 0.498 OK

Check Deflections(uniform loads only)
Delta-x(in): 0 =L/ #DIV/0!
Delta-y(in): 0 =L/ #DIV/0!

Torsion Check

Vx (k) =	0.01	fvx (ksi) =	0.01	Fv (ksi)=	18.4
Vy (k) =	0.01	fvy (ksi) =	0.01	U.C. =	0.00
T (k*ft)=	0.01	t (ksi) =	0.02		

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Engr: DLW

LSMCHOR
BF2 Brace

Section	ts4x4x1/4				
P (kip)	7.9	t (in)	0.25	klx/rx	179.60
Mx(K*ft)	0.00	b/t	16.00	kly/ry	179.60
My (K*ft)	0.00	Sx(in^3)	4.11	Cc(ksi)	111.55
Lx(ft)	22.6	Sy(in^3)	4.11	F'ex(ksi)	4.63
Ly(ft)	22.6	A	3.59	F'ey(ksi)	4.63
Ltot(ft)	22.6	rx	1.51	Ix(in^4)=	8.22
Fy(ksi)	46	ry	1.51	Iy(in^4)=	8.22
bx(in)	4	kx	1.00	bx/t =	16.00
by(in)	4	ky	1.00	by/t =	16.00
		W/S Load (Y/N) =	N		

Find Axial Allowable Stress
Controlling Slenderness Ratio = 179.60 OK
kl/r / Cc= 1.61
Fa (ksi) = 4.63
fa(ksi)= 2.20
fa/Fa= 0.475

Find Allowable Bending Stresses

Is Section Compact?		yes	yes
Lcx (ft)	14.13	Lcy(ft)	14.13
Fbx (ksi)	27.6	Fby (ksi)	27.6
fbx (ksi)	0.00	fby (ksi)	0.00

Check Combined Stresses
Is fa/Fa > 0.15 YES

Unity Chk. 0.475 OK

Check Deflections(uniform loads only)
Delta-x(in)= 0 =L/ #DIV/0!
Delta-y(in)= 0 =L/ #DIV/0!

Torsion Check

Vx (k) =	0.01	fvx (ksi) =	0.01	Fv (ksi)=	18.4
Vy (k) =	0.01	fvy (ksi) =	0.01	U.C. =	0.00
T (k*ft)=	0.01	t (ksi) =	0.02		

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Date: 12/18/2019
Engr: DLW
Proj:

LSMCHOR

Brace	hss4x4x1/4		Brace width (in) =	4			
Axial load (k)	13.2						
Angle (from hor.)	63.43	degrees or	1.107 radians				
Proposed Weld (in)	0.1875						
Rw (k/in)	2.78	E70 electrodes					
Lreq'd (in) =	1.19				Use	2.00	inches ea. side top & bot.

Beam Depth (in)=	0.00
Column Depth (in)=	4.00

Gusset Plate Design

Distance from edge of tube to beam (in)	2
Distance from W.P. to center of tube (in)	4.24
L1 (in)=	2.236165
L2 (in) =	4.236165
L3 (in)=	5.118082
Ldes (in)	3.86347

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2-6

Width of Whitemore Section (in) =	12.00					
Trial Plate Thickness =	0.375	Fy (ksi)= 36				
Ax (in^2) =	4.50					
Ix (in^4) =	0.05					
rx (in) =	0.11					
k	1.00					
kl/r =	35.69					
Fa (ksi) =	19.52	OK				
fa (ksi) =	2.93	OK				
Bolt diameter (in)	0.75					
Allow Bolt Shear (k)	9.28	For ASTM A325N bolts				
Horizontal Brace reaction (k) =	5.90	required weld length to beam (in) =	1.060309			
Vertical Brace reaction (k) =	11.81	required weld length to column (in) =	2.120161	-OR-	1.00	bolts
Beam Reaction (k) =	2	use	1	for ASTM A325N bolts		

2-7

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Date: 12/18/2019
Engr: DLW
Proj:

LSMCHOR

Brace	hss4x4x1/4		Brace width (in) =	4		
Axial load (k)	7.9					
Angle (from hor.)	45	degrees or	0.785 radians			
Proposed Weld (in)	0.1875					
Rw (k/in)	2.78	E70 electrodes				
Lreq'd (in) =	0.71			Use	1.00	inches ea. side top & bot.

Beam Depth (in)=	8.00
Column Depth (in)=	4.00

Gusset Plate Design

Distance from edge of tube to beam (in)	2
Distance from W.P. to center of tube (in)	10.49
L1 (in)=	2.828427
L2 (in) =	4.828427
L3 (in)=	5.414214
Ldes (in)	4.357023

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Width of Whitemore Section (in) =			6.00	
Trial Plate Thickness =			0.375	Fy (ksi)= 36
Ax (in^2) =	2.25			
Ix (in^4) =	0.03			
rx (in) =	0.11			
k	1.00			
kl/r =	40.25			
Fa (ksi) =	19.17	OK		
fa (ksi) =	3.51	OK		

Bolt diameter (in)	0.75	
Allow Bolt Shear (k)	9.28	For ASTM A325N bolts

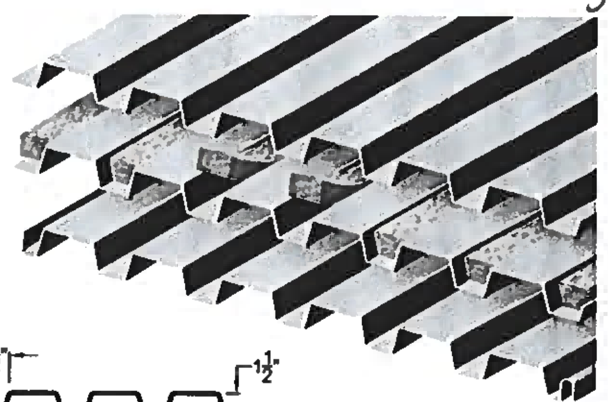
Horizontal Brace reaction (k) =	5.59	required weld length to beam (in) =	1.003184		
Vertical Brace reaction (k) =	5.59	required weld length to column (in) =	1.003184	-OR-	1.00 bolts

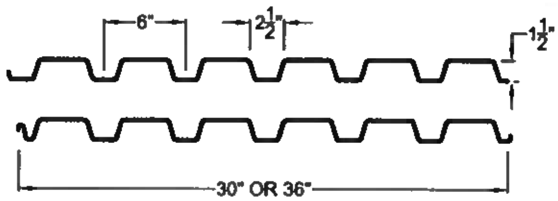
Beam Reaction (k) =	2	use	1	for ASTM A325N bolts

3-1

1.5 B, BI, BA, BIA, BSV

Maximum Sheet Length 42'-0
Extra charge for lengths under 6'-0
ICC ER-3415
FM Global Approved[2]





SECTION PROPERTIES

Deck type	Design thickness in.	W psf	Section Properties I_p	S_p	I_n	S_n	V_a lbs/ft	F_y ksi
			in^4/ft	in^3/ft	in^4/ft	in^3/ft		
B24	0.0239	1.46	0.107	0.120	0.135	0.131	2634	60
B22	0.0295	1.78	0.155	0.186	0.183	0.192	1818	33
B20	0.0358	2.14	0.201	0.234	0.222	0.247	2193	33
B19	0.0418	2.49	0.246	0.277	0.260	0.289	2546	33
B18	0.0474	2.82	0.289	0.318	0.295	0.327	2870	33
B16	0.0598	3.54	0.373	0.408	0.373	0.411	3578	33

ACOUSTICAL INFORMATION

Deck Type	Absorption Coefficient 125	250	500	1000	2000	4000	Noise Reduction Coefficient[1]
1.5BA, 1.5BIA	.11	.18	.66	1.02	0.61	0.33	0.60

[1] Source: Riverbank Acoustical Laboratories.
Test was conducted with 1.50 pcf fiberglass batts and 2 inch polyisocyanurate foam insulation for the SDI.

Type B (wide rib) deck provides excellent structural load carrying capacity per pound of steel utilized, and its nestable design eliminates the need for die-set ends.

1" or more rigid insulation is required for Type B deck.

Acoustical deck (Type BA, BIA) is particularly suitable in structures such as auditoriums, schools, and theatres where sound control is desirable. Acoustic perforations are located in the vertical webs where the load carrying properties are negligibly affected (less than 5%).

Inert, non-organic glass fiber sound absorbing batts are placed in the rib openings to absorb up to 60% of the sound striking the deck.

Batts are field installed and may require separation.

VERTICAL LOADS FOR TYPE 1.5B

No. of Spans	Deck Type	Max. SDI Const. Span	Allowable Total (PSF) / Load Causing Deflection of L/240 or 1 inch (PSF) — Span (ft.-in.) ctr to ctr of supports 5-0	5-6	6-0	6-6	7-0	7-6	8-0	8-6	9-0	9-6	10-0
1	B24	4'-8	115 / 56	95 / 42	80 / 32	68 / 26	59 / 20	51 / 17	45 / 14	40 / 11	35 / 10	32 / 8	29 / 7
	B22	5'-7	98 / 81	81 / 61	68 / 47	58 / 37	50 / 30	44 / 24	38 / 20	34 / 17	30 / 14	27 / 12	25 / 10
	B20	6'-5	123 / 105	102 / 79	86 / 61	73 / 48	63 / 38	55 / 31	48 / 26	43 / 21	38 / 18	34 / 15	31 / 13
	B19	7'-1	146 / 129	121 / 97	101 / 75	86 / 59	74 / 47	65 / 38	57 / 31	51 / 26	45 / 22	40 / 19	36 / 16
	B18	7'-8	168 / 152	138 / 114	116 / 88	99 / 69	85 / 55	74 / 45	65 / 37	58 / 31	52 / 26	46 / 22	42 / 19
	B16	8'-8	215 / 196	178 / 147	149 / 113	127 / 89	110 / 71	96 / 58	84 / 48	74 / 40	66 / 34	60 / 29	54 / 24
2	B24	5'-10	124 / 153	103 / 115	86 / 88	74 / 70	64 / 56	56 / 45	49 / 37	43 / 31	39 / 26	35 / 22	31 / 19
	B22	6'-11	100 / 213	83 / 160	70 / 124	59 / 97	51 / 78	45 / 63	39 / 52	35 / 43	31 / 37	28 / 31	25 / 27
	B20	7'-9	128 / 267	106 / 201	89 / 155	76 / 122	66 / 97	57 / 79	51 / 65	45 / 54	40 / 46	36 / 39	32 / 33
	B19	8'-5	150 / 320	124 / 240	104 / 185	89 / 145	77 / 116	67 / 95	59 / 78	52 / 65	47 / 55	42 / 47	38 / 40
	B18	9'-1	169 / 369	140 / 277	118 / 213	101 / 168	87 / 134	76 / 109	67 / 90	59 / 75	53 / 63	48 / 54	43 / 46
	B16	10'-3	213 / 471	176 / 354	149 / 273	127 / 214	110 / 172	95 / 140	84 / 115	74 / 96	66 / 81	60 / 69	54 / 59
3	B24	5'-10	154 / 120	128 / 90	108 / 69	92 / 55	79 / 44	69 / 35	61 / 29	54 / 24	48 / 21	43 / 17	39 / 15
	B22	6'-11	124 / 167	103 / 126	87 / 97	74 / 76	64 / 61	56 / 50	49 / 41	43 / 34	39 / 29	35 / 24	31 / 21
	B20	7'-9	159 / 209	132 / 157	111 / 121	95 / 95	82 / 76	72 / 62	63 / 51	56 / 43	50 / 36	45 / 31	40 / 26
	B19	8'-5	186 / 250	154 / 188	130 / 145	111 / 114	96 / 91	84 / 74	74 / 61	65 / 51	58 / 43	52 / 37	47 / 31
	B18	9'-1	210 / 289	174 / 217	147 / 167	126 / 132	108 / 105	95 / 86	83 / 71	74 / 59	66 / 50	59 / 42	54 / 36
	B16	10'-3	264 / 369	219 / 277	185 / 214	158 / 168	136 / 135	119 / 109	105 / 90	93 / 75	83 / 63	74 / 54	67 / 46

Notes: 1. Minimum exterior bearing length required is 1.50 inches. Minimum interior bearing length required is 3.00 inches. If these minimum lengths are not provided, web crippling must be checked.
2. FM Global approved numbers and spans available on page 21.

3-2

1.5 (B, F, A) 22 ALLOWABLE DIAPHRAGM SHEAR STRENGTH (PLF)

SUPPORT FASTENERS: 5/8" puddle welds[1]

SIDELAP FASTENERS: #10 TEK screws

Factor of safety = 2.35

ANY CONN ADEQUATE

	# OF SIDELAP FASTENERS	DIAPHRAGM SHEAR STRENGTH (PLF) — DECK SPAN (FT.-IN.) 3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	K1
36/7	0	484	420	366	323	289											0.486
	1	557	487	432	383	343	310	283									0.377
	2	626	550	489	440	397	359	328	301	278	259	241	227	214			0.308
	3	691	610	545	491	447	408	373	343	317	295	275	258	244	226	204	0.261
	4	751	667	598	541	493	452	418	384	355	330	309	283	252	226	204	0.226
	5	806	720	648	588	537	494	457	425	394	363	319	283	252	226	204	0.199
	6	857	769	696	633	580	534	495	461	417	363	319	283	252	226	204	0.178
	7	903	816	741	676	621	574	532	484	417	363	319	283	252	226	204	0.161
	8	946	859	783	717	661	611	568	484	417	363	319	283	252	226	204	0.147
	9	985	899	823	757	698	648	568	484	417	363	319	283	252	226	204	0.135
	10	1021	936	860	794	735	676	568	484	417	363	319	283	252	226	204	0.125

$D_B = 129$ $D_F = 226$ $D_A = 356$ K2= 870

	# OF SIDELAP FASTENERS	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	K1
36/5	0	428	376	335	299	267											0.583
	1	490	435	389	352	321	290	265									0.433
	2	546	488	440	399	365	336	309	284	263	244	228	214	202			0.345
	3	594	536	486	443	407	376	348	325	301	280	261	245	232	220	204	0.286
	4	637	579	529	485	446	413	384	359	336	316	295	277	252	226	204	0.245
	5	675	618	567	523	483	449	419	392	368	346	319	283	252	226	204	0.214
	6	707	652	602	558	518	483	451	423	398	363	319	283	252	226	204	0.190
	7	736	683	634	590	550	514	482	453	417	363	319	283	252	226	204	0.171
	8	761	710	663	619	580	544	511	481	417	363	319	283	252	226	204	0.155
	9	782	735	689	647	607	571	538	484	417	363	319	283	252	226	204	0.142
	10	801	756	713	671	633	597	564	484	417	363	319	283	252	226	204	0.131

$D_B = 758$ $D_F = 886$ $D_A = 974$ K2= 870

	# OF SIDELAP FASTENERS	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	K1
36/4	0	328	288	256	226	201											0.728
	1	388	345	310	281	255	230	210									0.509
	2	439	395	358	326	299	276	255	234	216	200	186	175	165			0.391
	3	482	438	400	367	339	314	292	272	254	236	220	207	195	185	176	0.318
	4	518	476	438	405	375	349	325	305	286	270	254	238	225	213	203	0.267
	5	548	508	471	438	408	381	357	335	316	298	282	268	252	226	204	0.231
	6	573	535	500	467	438	411	386	364	343	325	308	283	252	226	204	0.203
	7	594	559	525	494	464	437	413	390	369	350	319	283	252	226	204	0.181
	8	611	579	547	517	489	462	437	415	394	363	319	283	252	226	204	0.164
	9	626	596	567	538	510	484	460	437	416	363	319	283	252	226	204	0.149
	10	639	611	583	556	530	504	481	458	417	363	319	283	252	226	204	0.137

$D_B = 1072$ $D_F = 1216$ $D_A = 1282$ K2= 870

	# OF SIDELAP FASTENERS	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	K1
36/3	0	274	245	221	200	179											0.971
	1	319	290	265	243	224	207	191									0.617
	2	354	327	302	279	260	242	226	212	199	185	173	162	153			0.452
	3	381	356	332	310	290	272	256	241	228	215	204	194	183	173	165	0.356
	4	401	378	357	336	317	299	282	267	253	240	229	218	208	199	190	0.294
	5	417	397	377	358	339	322	306	290	276	263	251	240	230	220	204	0.251
	6	429	411	393	375	358	342	326	311	297	284	272	260	250	226	204	0.218
	7	439	423	407	390	374	359	344	329	316	303	290	279	252	226	204	0.193
	8	446	432	418	403	388	373	359	345	332	319	307	283	252	226	204	0.173
	9	453	440	427	414	400	386	373	360	347	334	319	283	252	226	204	0.157
	10	458	447	435	423	410	397	385	372	360	348	319	283	252	226	204	0.144

$D_B = 2209$ $D_F = 2428$ $D_A = 2442$ K2= 870

[1] A 3/8" x 1-1/4" arc seam weld shall be used with F deck or A deck.

$$G' = \frac{K_2}{3.78 + \frac{0.3 \cdot D_X}{\text{SPAN}} + 3 \cdot K_1 \cdot \text{SPAN}}, \text{ Kips/inch}$$

SPAN is in feet

Substitute D_B, D_F, or D_A for D_X

DIAPHRAGM

PEC
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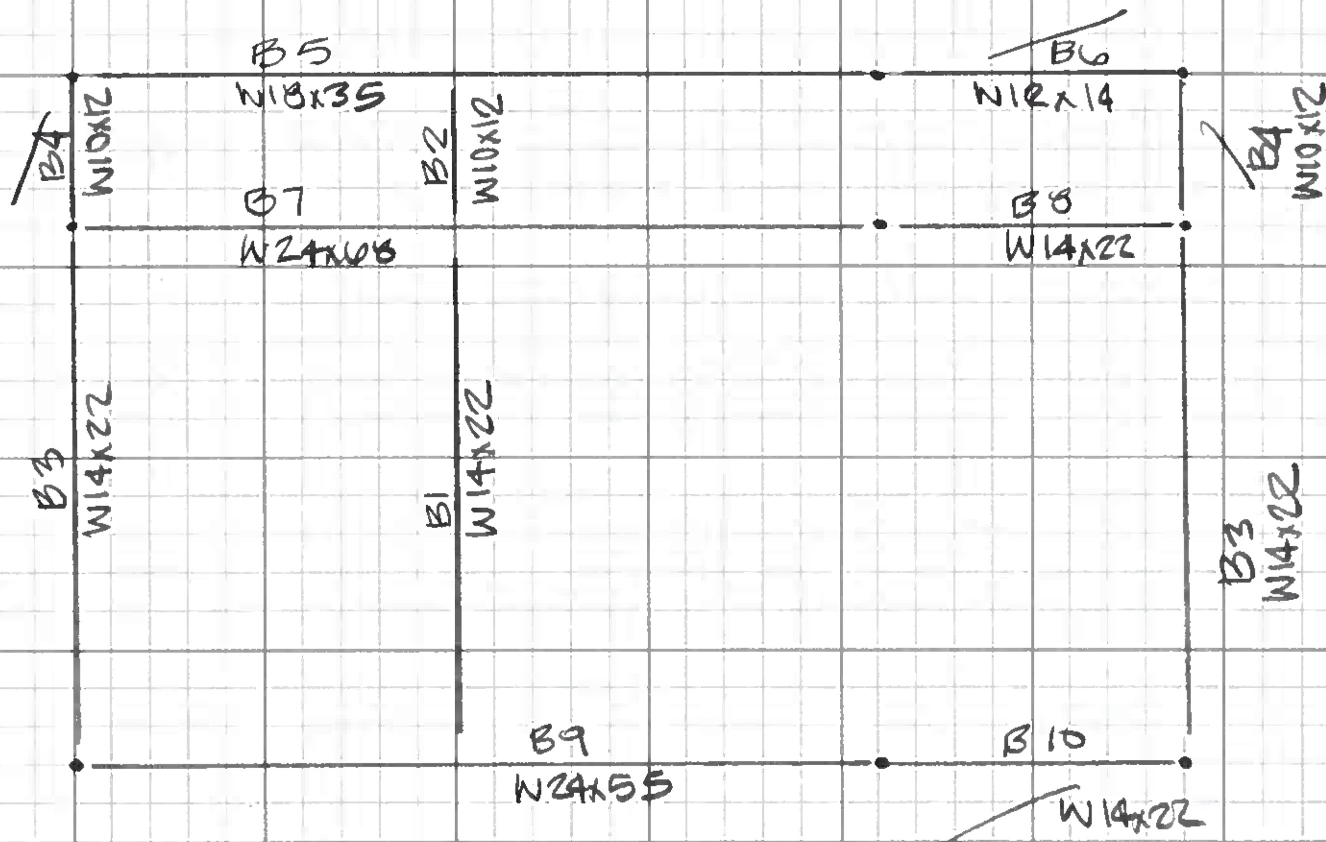
785-842-6464 | www.pec1.com

Project LSHOR Date 1.14.20

Item ALT ROOF FRAMING PLAN By DW



BEAM MK	L	w	M		SECTION	
B1	29'	0.28	29.4		W14x22	(SEE RE-FRAME)
B2	8'	0.28	2.2		W10x12	"
B3	29'	0.16	16.8		W14x22	
B4	8'	0.16	1.3		W10x12	
B5	42'6	0.26	58.7		W18x35	
B6	16	0.26	8.3		W12x14	"
B7	42'6	1.03	233		W24x68	"
B8	16	1.03	33	W18x35	~~W14x22~~	"
B9	42'6	0.81	183	W24x62	W24x55	"
B10	16	0.81	26	W18x35	W14x22	"

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LSMCHOR B1A

P (k) =	5.5	Section	w14x22		
Mx(k*ft)=	29.40	Ax(in^2)	6.49		
My(k*ft)=	0.00	rx (in) =	5.54	Ix(in^4)=	199.00
L tot(ft)=	29	ry (in) =	1.04	Iy(in^4)=	7.00
Lx (ft)=	29	rt (in) =	1.25	Sx(in^3)=	29.00
Ly (ft) =	2	d/Af =	8.20	Sy(in^3)=	2.80
Fy(ksi) =	50	bf (in) =	5.00	Lc(in) =	48.76
				Lu(in) =	53.74

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	62.85		
ky =	1	ky*ly/ry=	23.11		
Controlling slenderness ratio =	62.85			Cc =	107.00
Fa (ksi) =	22.23				
fa (ksi)=	0.85			kl/r / Cc	0.59
fa/Fa =	0.04				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	19.20
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	12.17	fbx/Fbx=	0.37
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	37.81	Cmx =	1.00
F'ey(ksi)=	279.63	Cmy =	1.00

Unity Check = 0.407 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.77	OR L/ 451
Hor. Defl.	0.00	OR L/ #DIV/0!

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LSMCHOR B2A

P (k) =	5.5	Section	W10X12		
Mx(k*ft)=	2.20	Ax(in^2)	3.54		
My(k*ft)=	0.00	rx (in) =	3.90	Ix(in^4)=	53.80
L tot(ft)=	9	ry (in) =	0.78	Iy(in^4)=	2.18
Lx (ft)=	9	rt (in) =	0.96	Sx(in^3)=	10.90
Ly (ft) =	2	d/Af =	11.87	Sy(in^3)=	1.10
Fy(ksi) =	50	bf (in) =	3.96	Lc(in) =	33.70
				Lu(in) =	42.56

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	27.70		
ky =	1	ky*ly/ry=	30.58		
Controlling slenderness ratio =		30.58		Cc =	107.00
Fa (ksi) =	27.08				
fa (ksi)=	1.55			kl/r / Cc	0.29
fa/Fa =	0.06				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	25.00
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	2.42	fbx/Fbx=	0.07
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	194.57	Cmx =	1.00
F'ey(ksi)=	159.65	Cmy =	1.00

Unity Check = 0.131 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.02	OR L/ 5253
Hor. Defl.	0.00	OR L/ #DIV/0!

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LSMCHOR B3A

P (k) =	5.5	Section	W14X22		
Mx(k*ft)=	16.30	Ax(in^2)	6.49		
My(k*ft)=	0.00	rx (in) =	5.54	Ix(in^4)=	199.00
L tot(ft)=	29	ry (in) =	1.04	Iy(in^4)=	7.00
Lx (ft)=	29	rt (in) =	1.25	Sx(in^3)=	29.00
Ly (ft) =	2	d/Af =	8.20	Sy(in^3)=	2.80
Fy(ksi) =	50	bf (in) =	5.00	Lc(in) =	48.76
				Lu(in) =	53.74

Calculate Allow. Axial Stress W/S load? (Y/N) N

kx =	1	kx*lx/rx =	62.85		
ky =	1	ky*ly/ry=	23.11		
Controlling slenderness ratio =		62.85		Cc =	107.00
Fa (ksi) =	22.23				
fa (ksi)=	0.85			kl/r / Cc	0.59
fa/Fa =	0.04				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	19.20
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	6.74	fbx/Fbx=	0.20
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	37.81	Cmx =	1.00
F'ey(ksi)=	279.63	Cmy =	1.00

Unity Check = 0.243 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.43	OR L/ 814
Hor. Defl.	0.00	OR L/ #DIV/0!

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LSMCHOR B4A

P (k) =	5.5	Section	W10X12		
Mx(k*ft)=	1.30	Ax(in^2)	3.54		
My(k*ft)=	0.00	rx (in) =	3.90	Ix(in^4)=	53.80
L tot(ft)=	9	ry (in) =	0.78	Iy(in^4)=	2.18
Lx (ft)=	9	rt (in) =	0.96	Sx(in^3)=	10.90
Ly (ft) =	2	d/Af =	11.87	Sy(in^3)=	1.10
Fy(ksi) =	50	bf (in) =	3.96	Lc(in) =	33.70
				Lu(in) =	42.56

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	27.70		
ky =	1	ky*ly/ry=	30.58		
Controlling slenderness ratio =		30.58		Cc =	107.00
Fa (ksi) =	27.08				
fa (ksi)=	1.55			kl/r / Cc	0.29
fa/Fa =	0.06				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	25.00
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	1.43	fbx/Fbx=	0.04
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	194.57	Cmx =	1.00
F'ey(ksi)=	159.65	Cmy =	1.00

Unity Check = 0.101 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.01	OR L/ 8890
Hor. Defl.	0.00	OR L/ #DIV/0!

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LSMCHOR B5A

P (k) =	5.5	Section	W18X35		
Mx(k*ft)=	59.00	Ax(in^2)	10.3		
My(k*ft)=	0.00	rx (in) =	7.04	Ix(in^4)=	510.00
L tot(ft)=	42.5	ry (in) =	1.22	Iy(in^4)=	15.30
Lx (ft)=	42.5	rt (in) =	1.49	Sx(in^3)=	57.60
Ly (ft) =	5	d/Af =	6.94	Sy(in^3)=	5.10
Fy(ksi) =	50	bf (in) =	6.00	Lc(in) =	57.63
				Lu(in) =	64.49

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	72.48		
ky =	1	ky*ly/ry=	49.23		
Controlling slenderness ratio =		72.48		Cc =	107.00
Fa (ksi) =	20.47				
fa (ksi)=	0.53			kl/r / Cc	0.68
fa/Fa =	0.03				

Caclulate Bending Stresses

Lb (in) =	60	L/rt =	40.27
Fbx (ksi) =	30.00	Cb =	1.00
fbx(ksi)=	12.29	fbx/Fbx=	0.41
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	28.43	Cmx =	1.00
F'ey(ksi)=	61.62	Cmy =	1.00

Unity Check = 0.436 OK

Check Deflections (Uniform loads only)

Vert. Defl.	1.30	OR L/ 393
Hor. Defl.	0.00	OR L/ #DIV/0!

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LSMCHOR **B6A**

P (k) =	5.5	Section	W12X14		
Mx(k*ft)=	~~8.30~~ 11.5 w/RTU-1	Ax(in^2)	4.16		
My(k*ft)=	0.00	rx (in) =	4.61	Ix(in^4)=	88.60
L tot(ft)=	16	ry (in) =	0.75	Iy(in^4)=	2.36
Lx (ft)=	16	rt (in) =	0.95	Sx(in^3)=	14.90
Ly (ft) =	5	d/Af =	13.33	Sy(in^3)=	1.19
Fy(ksi) =	50	bf (in) =	3.97	Lc(in) =	30.00
				Lu(in) =	42.67

Calculate Allow. Axial Stress W/S load? (Y/N) N

kx =	1	kx*lx/rx =	41.60		
ky =	1	ky*ly/ry=	79.66		
Controlling slenderness ratio =	79.66			Cc =	107.00
Fa (ksi) =	19.08				
fa (ksi)=	1.32			kl/r / Cc	0.74
fa/Fa =	0.07				

Caclulate Bending Stresses

Lb (in) =	60	L/rt =	63.16
Fbx (ksi) =	26.82	Cb =	1.00
fbx(ksi)=	~~6.68~~ 9.26	fbx/Fbx=	0.25
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	86.28	Cmx =	1.00
F'ey(ksi)=	23.53	Cmy =	1.00

Unity Check = ~~0.319~~ OK
0.415 w/RTU-1

Check Deflections (Uniform loads only)

Vert. Defl.	0.15	OR L/ 1290
Hor. Defl.	0.00	OR L/ #DIV/0!

W14x22 OK BY INSP

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LSMCHOR B7A

P (k) =	5.5	Section	W24X68		
Mx(k*ft)=	~~233.00~~ 273.6k'	~~Ax(in^2)~~	20.1		
My(k*ft)=	0.00	rx (in) =	9.54	Ix(in^4)=	1830.00
L tot(ft)=	42.5	ry (in) =	1.87	Iy(in^4)=	70.40
Lx (ft)=	42.5	rt (in) =	2.26	Sx(in^3)=	154.00
Ly (ft) =	5	d/Af =	4.62	Sy(in^3)=	15.71
Fy(ksi) =	50	bf (in) =	8.97	Lc(in) =	88.40
				Lu(in) =	96.36

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	53.45		
ky =	1	ky*ly/ry=	32.06		
Controlling slenderness ratio =		53.45		Cc =	107.00
Fa (ksi) =	23.80				
fa (ksi)=	0.27			kl/r / Cc	0.50
fa/Fa =	0.01				

Caclulate Bending Stresses

Lb (in) =	60	L/rt =	26.55
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	~~18.16~~ 21.3	fbx/Fbx=	0.55
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

$P_1 = 1.74k$ (BOOM 1)
$P_2 = 2.86k$ (BOOMS 2&3)

$M_1 = 11.43k'$
$M_2 = 29.17k'$
$M_\phi = \cancel{233.00}$
273.6k'

Check Combined Stresses

F'ex (ksi)=	52.27	Cmx =	1.00
F'ey(ksi)=	145.29	Cmy =	1.00

Unity Check = ~~0.562~~ 0.656 OK

Check Deflections (Uniform loads only)

Vert. Defl.	1.43	OR L/ 357	305
Hor. Defl.	0.00	OR L/ #DIV/0!	OK

W24x68 ✓ OK

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LSMCHOR ~~B9A~~ VOID

P (k) =	5.5	Section	W14X22		
Mx(k*ft)=	33.00	Ax(in^2)	6.49		
My(k*ft)=	0.00	rx (in) =	5.54	Ix(in^4)=	199.00
L tot(ft)=	16	ry (in) =	1.04	Iy(in^4)=	7.00
Lx (ft)=	16	rt (in) =	1.25	Sx(in^3)=	29.00
Ly (ft) =	5	d/Af =	8.20	Sy(in^3)=	2.80
Fy(ksi) =	50	bf (in) =	5.00	Lc(in) =	48.76
				Lu(in) =	53.74

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	34.67		
ky =	1	ky*ly/ry=	57.77		
Controlling slenderness ratio =		57.77		Cc =	107.00
Fa (ksi) =	23.09				
fa (ksi)=	0.85			kl/r / Cc	0.54
fa/Fa =	0.04				

Caclulate Bending Stresses

Lb (in) =	60	L/rt =	48.00
Fbx (ksi) =	29.57	Cb =	1.00
fbx(ksi)=	13.66	fbx/Fbx=	0.46
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

$P_{RN-1} = 7.0 + 25.5$
$= 32.5K$

Check Combined Stresses

F'ex (ksi)=	124.21	Cmx =	1.00
F'ey(ksi)=	44.74	Cmy =	1.00

$M = 98.9 + 33$
$= 131.9K'$

Unity Check = 0.499 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.26	OR L/ 729
Hor. Defl.	0.00	OR L/ #DIV/0!

BUMP TO W18x35

SEE FOLLOWING PAGE

Professional Engineering Consultants, P.A.
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LSMCHOR B8

P (k) =	0	Section	W18X35		
Mx(k*ft)=	131.90	Ax(in^2)	10.3		
My(k*ft)=	0.00	rx (in) =	7.04	Ix(in^4)=	510.00
L tot(ft)=	15.5	ry (in) =	1.22	Iy(in^4)=	15.30
Lx (ft)=	15.5	rt (in) =	1.49	Sx(in^3)=	57.60
Ly (ft) =	5	d/Af =	6.94	Sy(in^3)=	5.10
Fy(ksi) =	50	bf (in) =	6.00	Lc(in) =	57.63
				Lu(in) =	64.49

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	26.43		
ky =	1	ky*ly/ry=	49.23		
Controlling slenderness ratio =		49.23		Cc =	107.00
Fa (ksi) =	24.47				
fa (ksi)=	0.00			kl/r / Cc	0.46
fa/Fa =	0.00				

Caclulate Bending Stresses

Lb (in) =	60	L/rt =	40.27
Fbx (ksi) =	30.00	Cb =	1.00
fbx(ksi)=	27.48	fbx/Fbx=	0.92
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	213.73	Cmx =	1.00
F'ey(ksi)=	61.62	Cmy =	1.00

Unity Check = 0.916 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.39	OR L/ 482
Hor. Defl.	0.00	OR L/ #DIV/0!

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LSMCHOR B9A

P (k) =	5.5	Section	W24X55		
Mx(k*ft)=	183.00	Ax(in^2)	16.2		
My(k*ft)=	0.00	rx (in) =	9.13	Ix(in^4)=	1350.00
L tot(ft)=	42.5	ry (in) =	1.34	Iy(in^4)=	29.10
Lx (ft)=	42.5	rt (in) =	1.68	Sx(in^3)=	114.00
Ly (ft) =	5	d/Af =	6.66	Sy(in^3)=	8.31
Fy(ksi) =	50	bf (in) =	7.01	Lc(in) =	60.03
				Lu(in) =	75.29

Calculate Allow. Axial Stress

				W/S load? (Y/N)	N
kx =	1	kx*lx/rx =	55.87		
ky =	1	ky*ly/ry=	44.77		
Controlling slenderness ratio =		55.87		Cc =	107.00
Fa (ksi) =	23.41				
fa (ksi)=	0.34			kl/r / Cc	0.52
fa/Fa =	0.01				

Caclulate Bending Stresses

Lb (in) =	60	L/rt =	35.71
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	~~19.26~~ 27.68	fbx/Fbx=	0.58
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	47.84	Cmx =	1.00
F'ey(ksi)=	74.51	Cmy =	1.00

Unity Check = ~~0.598~~ 0.849 OK

Check Deflections (Uniform loads only)

Vert. Defl.	1.52	OR L/ ~~336~~ 237	
Hor. Defl.	0.00	OR L/	#DIV/0!

P_1 = 1.10K (Boom 1) @ 8'
P_2 = 2.86K (Booms 2&3) @ 17.0'
P_3 = 1.43K (BOOM 4) @ 28'
P_4 = 3.57K (AIR COND) @ 31'

M_1 = 7.14K'
M_2 = 29.17K'
M_3 = 13.66K'
M_4 = 29.95K'
M_x = 183.00K'

262.92K'

BUMP TO W24x62

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LSMCHOR B10A

P (k) =	5.5	Section	W14X22		
Mx(k*ft)=	26.00	Ax(in^2)	6.49		
My(k*ft)=	0.00	rx (in) =	5.54	Ix(in^4)=	199.00
L tot(ft)=	16	ry (in) =	1.04	Iy(in^4)=	7.00
Lx (ft)=	16	rt (in) =	1.25	Sx(in^3)=	29.00
Ly (ft) =	5	d/Af =	8.20	Sy(in^3)=	2.80
Fy(ksi) =	50	bf (in) =	5.00	Lc(in) =	48.76
				Lu(in) =	53.74

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	34.67		
ky =	1	ky*ly/ry=	57.77		
Controlling slenderness ratio =		57.77		Cc =	107.00
Fa (ksi) =	23.09				
fa (ksi)=	0.85			kl/r / Cc	0.54
fa/Fa =	0.04				

Caclulate Bending Stresses

Lb (in) =	60	L/rt =	48.00
Fbx (ksi) =	29.57	Cb =	1.00
fbx(ksi)=	10.76	fbx/Fbx=	0.36
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

P1= 12.8K @ MID
M1= 49.6K'
MTOT= 75.6K

Check Combined Stresses

F'ex (ksi)=	124.21	Cmx =	1.00
F'ey(ksi)=	44.74	Cmy =	1.00

Unity Check = 0.401 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.21	OR L/ 925
Hor. Defl.	0.00	OR L/ #DIV/0!

BUMP to W18x35
FOR FIT

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Project LSMCHOR Date 3·17·20
Item ROOF RE-FRAME By DW

B1-A (B1 w/ 2 BOOM LOADS)

BOOM LOADS $P = 2k$, $M = 12k'$

$M = 29.4k' + 24k' + [2(29)/4]2 = 82.43k'$

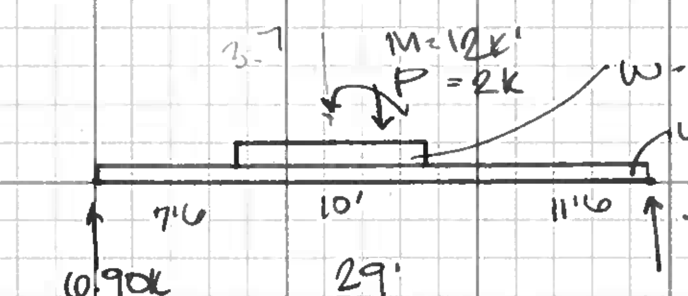
USE W16x31

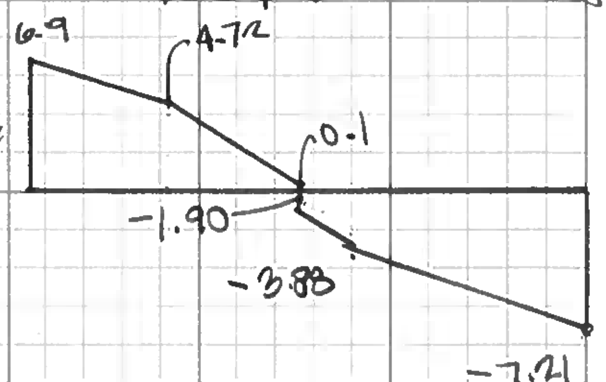
B1-B (B1 w BOOM & COND-01)

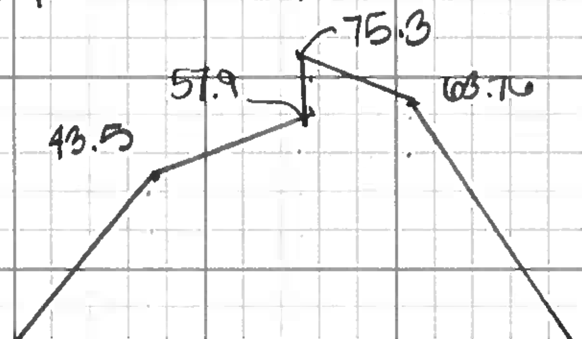
$P = 2k$, $M = 12k'$

AC UNIT = 2500# x 1.5 = 3.75k
+ 1.0k (CURB)
4.75k / 2 BMS = 2.38k
÷10' = 0.24k/ft

ADD 4" CONC = 50 psf x 2.5' / 1000 = 125 plf = 0.13k/ft







USE W16x31

Professional Engineering Consultants, P.A.		Page:	3-10
623 Massachusetts Street, Suite 200		Date:	3/17/2020
Lawrence, Kansas 66044		Engr.:	DLW

LSMCHOR B1A

P (k) =	0	Section	w16x31		
Mx(k*ft)=	82.43	Ax(in^2)	9.12		
My(k*ft)=	0.00	rx (in) =	6.41	Ix(in^4)=	375.00
L tot(ft)=	29	ry (in) =	1.17	Iy(in^4)=	12.40
Lx (ft)=	29	rt (in) =	1.39	Sx(in^3)=	47.20
Ly (ft) =	2	d/Af =	6.53	Sy(in^3)=	4.49
Fy(ksi) =	50	bf (in) =	5.53	Lc(in) =	59.38
				Lu(in) =	61.23

Calculate Allow. Axial Stress

				W/S load? (Y/N)	N
kx =	1	kx*lx/rx =	54.27		
ky =	1	ky*ly/ry=	20.58		
Controlling slenderness ratio =		54.27		Cc =	107.00
Fa (ksi) =	23.67				
fa (ksi)=	0.00			kl/r / Cc	0.51
fa/Fa =	0.00				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	17.27
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	20.96	fbx/Fbx=	0.64
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	50.70	Cmx =	1.00
F'ey(ksi)=	352.50	Cmy =	1.00

Unity Check = 0.635 OK

Check Deflections (Uniform loads only)

Vert. Defl.	1.15	OR L/	303
Hor. Defl.	0.00	OR L/	#DIV/0!

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LSMCHOR B1B

P (k) =	0	Section	w16x31		
Mx(k*ft)=	75.30	Ax(in^2)	9.12		
My(k*ft)=	0.00	rx (in) =	6.41	Ix(in^4)=	375.00
L tot(ft)=	29	ry (in) =	1.17	Iy(in^4)=	12.40
Lx (ft)=	29	rt (in) =	1.39	Sx(in^3)=	47.20
Ly (ft) =	2	d/Af =	6.53	Sy(in^3)=	4.49
Fy(ksi) =	50	bf (in) =	5.53	Lc(in) =	59.38
				Lu(in) =	61.23

W/S load? (Y/N) N

Calculate Allow. Axial Stress

kx =	1	kx*lx/rx =	54.27		
ky =	1	ky*ly/ry=	20.58		
Controlling slenderness ratio =		54.27		Cc =	107.00
Fa (ksi) =	23.67				
fa (ksi)=	0.00			kl/r / Cc	0.51
fa/Fa =	0.00				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	17.27
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	19.14	fbx/Fbx=	0.58
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	50.70	Cmx =	1.00
F'ey(ksi)=	352.50	Cmy =	1.00

Unity Check = 0.580 OK

Check Deflections (Uniform loads only)

Vert. Defl.	1.05	OR L/ 332
Hor. Defl.	0.00	OR L/ #DIV/0!

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Project: LSMCHOR   Date: 3.17.20
Item: ROOF RE-FRAME   By: DW

B1-C (B1 w/ RTU-1 & CONC)

$W_{UNIT} = [40psf \times 2.5 + 15500(1.5)/30]/1000 = 0.875$

$W_{BASE} = 0.29 K/ft$

$w = 0.88$
$w = 0.29$
$w_{TOT} = 1.17 K/ft$

$M = 123.0 K \cdot ft$

USE W18x35

B2-A (B2 w/ PARTITION)

$P_{PART} = 1.0K$
$M_{PART} = 3.3K$

$W = 0.29 K/ft$

$L = 8'6$

$M_{TOT} = 1.0(8.5)/4 + 0.29(8.5)^2/8 + 3.3 = 8.04 K \cdot ft$

USE W8x24 ($b_f > 6$)

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LSMCHOR BIC

P (k) =	0	Section	W18X35		
Mx(k*ft)=	123.00	Ax(in^2)	10.3		
My(k*ft)=	0.00	rx (in) =	7.04	Ix(in^4)=	510.00
L tot(ft)=	29	ry (in) =	1.22	Iy(in^4)=	15.30
Lx (ft)=	29	rt (in) =	1.49	Sx(in^3)=	57.60
Ly (ft) =	2	d/Af =	6.94	Sy(in^3)=	5.10
Fy(ksi) =	50	bf (in) =	6.00	Lc(in) =	57.63
				Lu(in) =	64.49

W/S load? (Y/N) N

Calculate Allow. Axial Stress

kx =	1	kx*lx/rx =	49.46		
ky =	1	ky*ly/ry=	19.69		
Controlling slenderness ratio =		49.46		Cc =	107.00
Fa (ksi) =	24.44				
fa (ksi)=	0.00			kl/r / Cc	0.46
fa/Fa =	0.00				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	16.11
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	25.63	fbx/Fbx=	0.78
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	61.06	Cmx =	1.00
F'ey(ksi)=	385.11	Cmy =	1.00

Unity Check = 0.777 OK

Check Deflections (Uniform loads only)

Vert. Defl.	1.26	OR L/ 276
Hor. Defl.	0.00	OR L/ #DIV/0!

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LSMCHOR B2A

P (k) =	0	Section	W8X24		
Mx(k*ft)=	8.04	Ax(in^2)	7.08		
My(k*ft)=	0.00	rx (in) =	3.42	Ix(in^4)=	82.80
L tot(ft)=	8.5	ry (in) =	1.61	Iy(in^4)=	18.30
Lx (ft)=	8.5	rt (in) =	1.76	Sx(in^3)=	20.90
Ly (ft) =	2	d/Af =	3.05	Sy(in^3)=	5.64
Fy(ksi) =	50	bf (in) =	6.50	Lc(in) =	69.81
				Lu(in) =	131.05

Calculate Allow. Axial Stress

W/S load? (Y/N) N

kx =	1	kx*lx/rx =	29.83		
ky =	1	ky*ly/ry=	14.93		
Controlling slenderness ratio =		29.83		Cc =	107.00
Fa (ksi) =	27.17				
fa (ksi)=	0.00			kl/r / Cc	0.28
fa/Fa =	0.00				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	13.64
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	4.62	fbx/Fbx=	0.14
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	167.86	Cmx =	1.00
F'ey(ksi)=	670.11	Cmy =	1.00

Unity Check = 0.140 OK

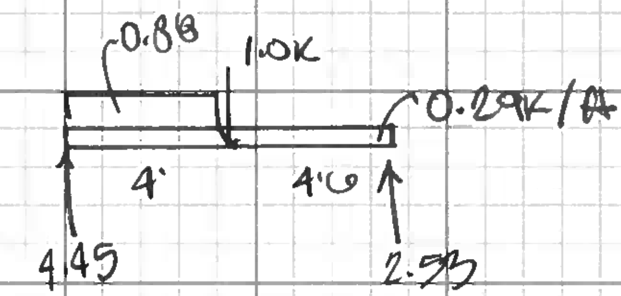
Check Deflections (Uniform loads only)

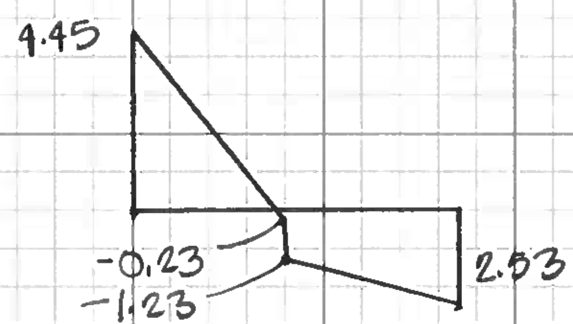
Vert. Defl.	0.04	OR L/ 2342
Hor. Defl.	0.00	OR L/ #DIV/0!

Project LSMCHOR Date 3.17.20

Item ROOF RB-FRAME By DW

B2-B (B1 w/ RTU-1)





$M_{MAX} = 8.90K' + 3.3K'$

$= 12.2K \cdot ft$

$b_f \geq 6"$

USE W8x24

CHK ALSO BMS B6, B7, B8, B9 & B10

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LSMCHOR B2B

P (k) =	0	Section	W8X24		
Mx(k*ft)=	12.20	Ax(in^2)	7.08		
My(k*ft)=	0.00	rx (in) =	3.42	Ix(in^4)=	82.80
L tot(ft)=	8.5	ry (in) =	1.61	Iy(in^4)=	18.30
Lx (ft)=	8.5	rt (in) =	1.76	Sx(in^3)=	20.90
Ly (ft) =	2	d/Af =	3.05	Sy(in^3)=	5.64
Fy(ksi) =	50	bf (in) =	6.50	Lc(in) =	69.81
				Lu(in) =	131.05

W/S load? (Y/N) N

Calculate Allow. Axial Stress

kx =	1	kx*lx/rx =	29.83		
ky =	1	ky*ly/ry=	14.93		
Controlling slenderness ratio =		29.83		Cc =	107.00
Fa (ksi) =	27.17				
fa (ksi)=	0.00			kl/r / Cc	0.28
fa/Fa =	0.00				

Caclulate Bending Stresses

Lb (in) =	24	L/rt =	13.64
Fbx (ksi) =	33.00	Cb =	1.00
fbx(ksi)=	7.00	fbx/Fbx=	0.21
Fby(ksi)=	37.5		
fby(ksi)=	0.00	fby/Fby=	0.00

Check Combined Stresses

F'ex (ksi)=	167.86	Cmx =	1.00
F'ey(ksi)=	670.11	Cmy =	1.00

Unity Check = 0.212 OK

Check Deflections (Uniform loads only)

Vert. Defl.	0.07	OR L/ 1544
Hor. Defl.	0.00	OR L/ #DIV/0!

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Project LSMCHOR

Date 12.19.19

Item COL. DESIGN

By DN

COL MK	C1	C2	C3	C4	C5	C6	C7
P_D	1.7	2.4	0.6	11.0	13.9	2.9	9.2
P_L	1.7	2.4	0.6	7.9	10.8	2.9	6.2
P_W	-1.4	-1.9	-0.5	-6.3	-8.6	-2.3	-4.9
P_{BRACE}	±11.8K	±5.6	±11.8	±11.8	—	±11.8	—
P_{MAX}	10.8	7.0	9.5	21.1	24.7	12.2	15.4
P_{MIN}	-12.2K	-6.1	-11.9	-11.5	-0.3	-12.4	0.6
SECTION	← HSS 4x4x1/4 →						
BASE PL	← PL 3/4 x 10 x 0'-10" →						
ANCH BOLT	← (4) 3/4" Φ →						
GR. BM* LOAD	~~38K~~	~~57K~~	~~18K~~	~~28K~~	~~28K~~	~~28K~~	~~27*~~
P_{TOT}	~~49K~~	~~64K~~	~~28K~~	~~50K~~	~~53K~~	~~41K~~	~~45*~~
PIER Φ	30"Φ w/(16) #6 @ #3 TIES @ 12" o.c.						
~~REINF~~ FTG ALT. w/o G.B.	~~4'6" SQ~~ 3'0" SQ	~~5'6" SQ~~ 3'6" SQ	~~6'6" SQ~~ 5'0" SQ	~~5'6" SQ~~ 5'6" SQ	4'0" SQ	~~5'6" SQ~~ 5'0" SQ	24x4

* CANTILEVER CALCULATED

* ASSUME = ~~1.5K/ft~~ 2.0K/ft FOR CANTILEVERS 1.0K/ft ELSEWHERE

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Project LSMCHOR
Date 12.19.19
Item COL. DESIGN
By DW

COL MK	C8	C9
P_D	11.5	2.3
P_L	8.5	2.3
P_W	-6.7	-1.8
P_{BRACE}	±5.6	±5.6
P_{MAX}	20.0 0K ~~20.0~~	6.9K ~~4.6~~ -6.0
P_{MIN}	~~0.2~~ 0.20K	~~-0.4~~
SECTION	HSS 4x4x¼	
BASE PL	PL ¾x10x0'10"	
ANCH BOLT	(4) ¾"Φ	
GR. BM. LOAD	~~27K~~ ☆	~~27K~~ ☆
P_{TOT}	~~52.4~~ ☆	~~33K~~ ☆
PIER Φ	30"Φ w/ (16) #6 & #3 TIES @ 12" o.c.	
~~REINF~~ DCT FTG	2'4x4'6	2'4x4'0

☆ CANTILEVER CALCULATED

Professional Engineering Consultants, P.A.		Page:	4-3
623 Massachusetts Stret, Suite 200		Date:	12/19/2019
Lawrence, Kansas 66044		Engr:	DLW

LSMCHOR
Column Design

Section	ts4x4x1/4				
P (kip)	33.15	t (in)	0.25	klx/rx	127.15
Mx(K*ft)	0.00	b/t	16.00	kly/ry	127.15
My (K*ft)	0.00	Sx(in^3)	4.11	Cc(ksi)	111.55
Lx(ft)	16	Sy(in^3)	4.11	F'ex(ksi)	9.24
Ly(ft)	16	A	3.59	F'ey(ksi)	9.24
Ltot(ft)	16	rx	1.51	Ix(in^4)=	8.22
Fy(ksi)	46	ry	1.51	Iy(in^4)=	8.22
bx(in)	4	kx	1.00	bx/t =	16.00
by(in)	4	ky	1.00	by/t =	16.00
		W/S Load (Y/N) =	N		

Find Axial Allowable Stress
Controlling Slenderness Ratio = 127.15 OK
kl/r / Cc= 1.14
Fa (ksi) = 9.24
fa(ksi)= 9.23
fa/Fa= 1.000

Find Allowable Bending Stresses

Is Section Compact?		yes	yes
Lcx (ft)	14.13	Lcy(ft)	14.13
Fbx (ksi)	27.6	Fby (ksi)	27.6
fbx (ksi)	0.00	fby (ksi)	0.00

Check Combined Stresses
Is fa/Fa > 0.15 YES

Unity Chk. 1.000 OK

Check Deflections(uniform loads only)
Delta-x(in): 0 =L/ #DIV/0!
Delta-y(in): 0 =L/ #DIV/0!

Torsion Check

Vx (k) =	0.01	fvx (ksi) =	0.01	Fv (ksi)=	18.4
Vy (k) =	0.01	fvy (ksi) =	0.01	U.C. =	0.00
T (k*ft)=	0.01	t (ksi) =	0.02		

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Lawrence, Kansas 66044

Date: 12/19/2019
Engr: DLW

LSMCHOR

Base Plate Design Program

P(kip)=	24.70		f'c(ksi) =	4.00
T(kip)=	12.40		Fp(ksi) =	1.40
V(kip)=	5.90		Fy(ksi)=	36
Column Section		ts4x4x1/4		
d(in)=	4.00			
bf(in) =	4.00			

Assume A Base Plate Size

B (in) =	10.00		2n(in) =	6.40
N (in) =	10.00		2m(in)=	6.40
A(in^2)=	100.00		PL ext 1 =	3.00
fp(ksi)=	0.25	OK	PL ext 2 =	3.00

Base Plate Thk. (in)= 0.53

Check Anchor Bolts For Tension and Shear

Bolt diameter (in)=	0.75	Bolt area(in^2) =		0.442
Allow Shear/bolt =	4.42	Fv(ksi) =	10.00	
Allow. Tension/bolt =	8.84	Ft(ksi) =	20.00	
Number Required=	1.40	Use	2	0.75 " dia bolts.

Check Combined Shear And Tension

V/Bolt (k)=	2.95	fv(ksi)=	6.68	OK
T/bolt (k)=	6.20	ft(ksi)=	14.03	OK

Check Prying Action (across corners)

Anchor Bolt Ga.(in)=	9.00		b=	1.50	b'=	1.125
Required Plate Thickness(in)=		0.56	a=	1.50	a'=	1.875

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LSMCHOR Typ footings

FOOTING DESIGN SPREADSHEET

P-live(K)	11	M-live (K*FT)	0	f'c (KSI) =	4
P-dead (K)	11	M-dead (K*FT)	0	fy (KSI) =	60
Ptot (K)	22	Mtot (K*FT)	0	Height	0
Pu (K) =	34.10	Mu (K*FT)	0	Density (kcf)	0.1

CHECK BEARING

ALLOWABLE BRG. PRESS. (KSF) 2

B (FT) =	3.5				
N (FT) =	3.5				
T (FT) =	1	d (IN) =	8.75		
A (SQ. FT)	12.25				
FTG. WT (K) =	1.84	OVERBURDEN WT=	0.00	0.6*WT (k)=	1.10
P-adj.(K)=	23.84	Pu-adj (K)	36.6725	Adj. L.F.	1.54
e (FT) =	0				

MAXIMUM BEARING PRESSURE (KSF) = 1.95 OK
MINIMUM BEARING PRESSURE (KSF) = 1.95 OK

CHECK PUNCHING SHEAR

b (IN) =	10		bo (IN) =	75
n (IN) =	10		PUNCHING SHEAR AREA (SQ. FT.) =	2.4414063
Vu (K) =	29.36		PILASTER WT (K) =	0.00
Phi*Vc =	141.12	OK		

CHECK 1-WAY SHEAR

Vu (K) =	10.70	
Phi*Vc =	39.51	OK

CHECK BENDING

Mu (K*FT) =		2.661043				
TRY #	4	BARS @	6	INCH CTRS.		
As (SQ. IN.) =		0.39	>	(4/3)As-required=	0.09	
a(in)=	0.58			Temp. Steel req'd =	0.19	OK
ϕMn =	14.95	OK				

UPLIFT CAPACITY = (3K + 1.8K)(0.6)
2.9K

+ GR. BM @ 1.1K/ft

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LSMCHOR Typ footings

FOOTING DESIGN SPREADSHEET

P-live(K)	18	M-live (K*FT)	0	f'c (KSI) =	4
P-dead (K)	18	M-dead (K*FT)	0	fy (KSI) =	60
Ptot (K)	36	Mtot (K*FT)	0	Height	0
Pu (K) =	55.80	Mu (K*FT)	0	Density (kcf)	0.1

CHECK BEARING

ALLOWABLE BRG. PRESS. (KSF) 2

B (FT) = 4.5
N (FT) = 4.5
T (FT) = 1 d (IN) = 8.75
A (SQ. FT) 20.25
FTG. WT (K) = 3.04 OVERBURDEN WT= 0.00 0.6*WT (k)= 1.82
P-adj.(K)= 39.04 Pu-adj (K) 60.0525 Adj. L.F. 1.54
e (FT) = 0

MAXIMUM BEARING PRESSURE (KSF) = 1.93 OK
MINIMUM BEARING PRESSURE (KSF) = 1.93 OK

CHECK PUNCHING SHEAR

b (IN) = 10 bo (IN) = 75
n (IN) = 10 PUNCHING SHEAR AREA (SQ. FT.) = 2.4414063
Vu (K) = 52.81 PILASTER WT (K) = 0.00
Phi*Vc = 141.12 OK

CHECK 1-WAY SHEAR

Vu (K) = 20.30
Phi*Vc = 50.80 OK

CHECK BENDING

Mu (K*FT) = 4.983781
TRY # 4 BARS @ 6 INCH CTRS.
As (SQ. IN.) = 0.39 > (4/3)As-required= 0.17
a(in)= 0.58 Temp. Steel req'd = 0.19 OK
ϕMn = 14.95 OK

UPLIFT CAPACITY (3+3)0.6= 3.6K

+ GR. BM. WT.

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Date: 2/5/2020
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LSMCHOR — Typ footings

FOOTING DESIGN SPREADSHEET

P-live(K)	27	M-live (K*FT)	0	f'c (KSI) =	4
P-dead (K)	27	M-dead (K*FT)	0	fy (KSI) =	60
Ptot (K)	54	Mtot (K*FT)	0	Height	0
Pu (K) =	83.70	Mu (K*FT)	0	Density (kcf)	0.1

CHECK BEARING

ALLOWABLE BRG. PRESS. (KSF) 2

B (FT) =	5.5				
N (FT) =	5.5				
T (FT) =	1	d (IN) =	8.75		
A (SQ. FT)	30.25				
FTG. WT (K) =	4.54	OVERBURDEN WT=	0.00	0.6*WT (k)=	2.72
P-adj.(K)=	58.54	Pu-adj (K)	90.0525	Adj. L.F.	1.54
e (FT) =	0				

MAXIMUM BEARING PRESSURE (KSF) =	1.94	OK
MINIMUM BEARING PRESSURE (KSF) =	1.94	OK

CHECK PUNCHING SHEAR

b (IN) =	10		bo (IN) =	75
n (IN) =	10		PUNCHING SHEAR AREA (SQ. FT.) =	2.4414063
Vu (K) =	82.78		PILASTER WT (K) =	0.00
Phi*Vc =	141.12	OK		

CHECK 1-WAY SHEAR

Vu (K) =	33.09	
Phi*Vc =	62.09	OK

CHECK BENDING

Mu (K*FT) =		8.103898				
TRY #	4	BARS @	6	INCH CTRS.		
As (SQ. IN.) =		0.39	>	(4/3)As-required=	0.28	
a(in)=	0.58			Temp. Steel req'd =	0.19	OK
ϕMn =	14.95	OK				

UPLIFT CAPACITY ≈ (3.0 + 4.5)(0.6)
= 4.5K
+ GR. BM WT.

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Project LSMCHOR Date 3.1.20

Item ECCENTRIC FOOTINGS By DW

C1

P_{COL}: 15.4K
P_{RL}: 2.8K

P_{TOT} = 18.2K

ALLOW BRG PRESSURE = 2.0KSF

A_{REQD} = 9.1 S.F.

CONTROLLED DIM = 2'4" = 2x 1'2" (TO MAINTAIN SYMMETRY)

L_{REQD} = 9.1/2.33 = 3.90 ft

$\boxed{\text{USE 2'4" x 4'0" x 1'0" FOOTING W/ \#4 @ 6" O.C. B.W.}}$

C2

P_{COL}: 20.0K

A_{REQD} = 20K / 2KSF = 10 S.F.

L_{REQD} = 10SF / 2.33 = 4.29 ft

$\boxed{\text{USE 2'4" x 4'6" x 1'0" FOOTING W/ \#4 @ 6" O.C. B.W.}}$

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Item EQUIP SUPPORTS By DW

REQ'D EQUIP LOADS

WT = 2.02K
M = 12.85K' } ON 28" SQ FP (@ 6" SQ ON EA COR)

TENS. COMP = 2.02K / 4 = 0.51K

MOM. COMP = (12.85K' / 22")(12in/ft)(2) ±3.5K (SIDE-SIDE)

OR

12.85(12)/22√2 = ± 5.0K (COR-COR)

∴ TMAX = 4.0K SIDE-SIDE

5.5K COR-COR

SUPPORT MEMBER @ BOT OF STR.

L = 5'0" MAX.

MMAX = ~~5.0K~~ 5.5K (~~5.0'~~ 5.0')/4 = ~~6.25K'~~ 6.88K'

IF ANGLE S > ~~3.47 in³~~ 3.82 ~~L6x4x½ (LLV) (16.2)~~

IF HSS S > ~~2.72 in³~~ 2.99 HSS 4x4x¼ (12.2) ✓

IF WT S > ~~2.50 in³~~ 2.75 WT6x15 (15) ✓

WT IS LIGHTER AND EASIER TO CONNECT THAN HSS.

HANGER

TMAX = 5.5K → Ar = 0.25in²

L3x3x¼ IS OK (S~ IS SMALLER)

BRACE

T = C = 5.0K √2 = 7.07K

L = 42"

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Item EQUIP SUPPORTS- By DW

$KL/r < 200 \quad \therefore \quad 1.0(42)/r \leq 200$

$r \geq 0.21$

TRY L3x3x1/4 $r = 0.592$

$KL/r = 70.9 < C_c$ $KL/r/C_c = 0.563$

$F_a = 30.3 / \frac{5}{3} + 0.211 - 0.022 = 16.3\,ksi$

$f_a = 7.07/1.44 = 4.9\,ksi < 16.3\,ksi$ L3x3x1/4 OK