STRUCTURAL ENGINEERING CALCULATIONS

FOR

HCA – Surgery Center of Lee's Summit
1950 SE Shenandoah Drive
LEE'S SUMMIT, MISSOURI, 64063

PREPARED BY

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FOR

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February 8th, 2023

GENERAL LOAD ANALYSIS

⚠ This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

ℹ The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

ATC Hazards by Location

Search Information

Coordinates: 38.903781, -94.335948

Elevation: 1002 ft

Timestamp: 2022-11-22T14:25:07.601Z

Hazard Type: Wind

ASCE 7-16		ASCE 7-10		ASCE 7-05	
MRI 10-Year	75 mph	MRI 10-Year	76 mph	ASCE 7-05 Wind Speed	90 mph
MRI 25-Year	83 mph	MRI 25-Year	84 mph		
MRI 50-Year	88 mph	MRI 50-Year	90 mph		
MRI 100-Year	94 mph	MRI 100-Year	96 mph		
Risk Category I	103 mph	Risk Category I	105 mph		
Risk Category II	109 mph	Risk Category II	115 mph		
Risk Category III	117 mph	Risk Category III-IV	120 mph		
Risk Category IV	122 mph				

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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: 38.903781, -94.335948

Elevation: 1002 ft

Timestamp: 2022-11-22T14:25:36.530Z

Hazard Type: Snow

ASCE 7-16		ASCE 7-10		ASCE 7-05	
Ground Snow Load	20 lb/sqft	Ground Snow Load	20 lb/sqft	Ground Snow Load	20 lb/sqft

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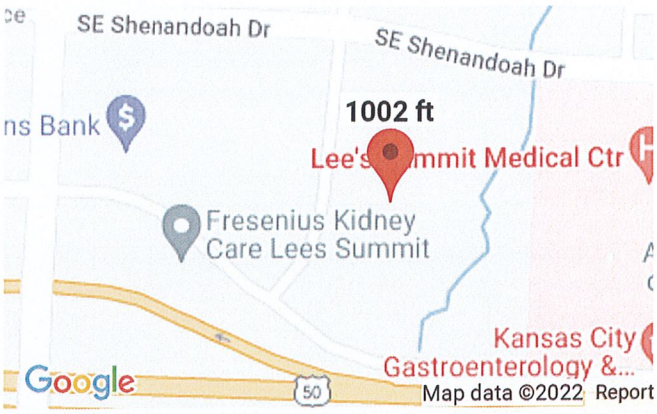
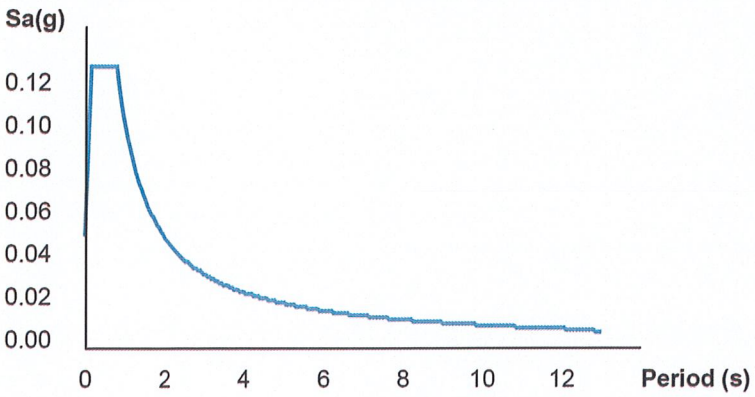
Hazards by Location

Search Information

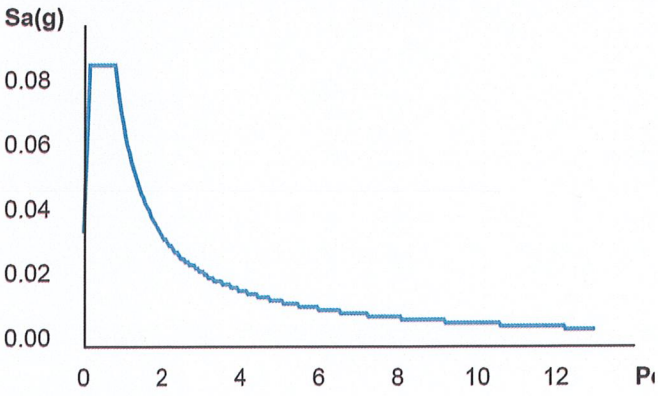
Coordinates:	38.903781, -94.335948
Elevation:	1002 ft
Timestamp:	2022-11-22T14:26:28.012Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	C



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



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}	0.131	Site-modified spectral acceleration value
S_{M1}	0.103	Site-modified spectral acceleration value
S_{DS}	0.087	Numeric seismic design value at 0.2s SA
S_{D1}	0.069	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description

SDC	B	Seismic design category
F_a	1.3	Site amplification factor at 0.2s
F_v	1.5	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}	1.3	Site amplification factor at PGA
PGA_M	0.062	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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Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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SEISMIC LOADS:

S_{DS} = .087 S_{D1} = .069 (SDC B) (SITE CLASS C)

USE EQUIVALENT LATERAL FORCE PROCEDURE

$V = C_S W$ WHERE $C_S = S_{DS}/R/I$ WHERE $S_{DS} = .087$

R = 3.0 (Ord Concentrically Braced Frames Not Specifically Detailed for Seismic)

$C_S = .087/3/1.0 = .029$ I = 1.0

$C_{S\,MIN} = .01$

DETERMINE $C_{S\,MAX}$:

$T = T_a = C_t h_n^x$ WHERE $C_t = .02$

$= (.02)(20)^{.75}$ $h_n = 20'-0"$

$= .189$

T_L = 12 SEC → T_a : T = 1.52 $C_{S\,MAX} = S_{D1}/T(R/I) = .069/.189(3/1.0) = .122$

$C_{S\,MAX} = .122$

$C_{S\,MIN} = .01 < C_S = .029 < C_{S\,MAX} = .122$

∴ $C_S = .029$

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SNOW LOADS:

$P_f = 0.7 C_e C_t I_s P_g$ where $P_g = 20$ psf

$I_s = 1.0$ (Cat II)

$C_e = 1.0$

$C_t = 1.0$

$(0.7)(1.0)(1.0)(1.0)(20)$

$= 14$ psf

$P_m = (1.0)(20) = 20$ psf > 14

$P_f = 20$ psf

USE $P_f = 20$ psf

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WIND LOADS (PER ASCE 07-16)

CHAPTER 27 DIRECTIONAL PROCEDURE

$P = q_h G C_p - q_i (GC_{pi})$

WHERE $q = .00256 K_z K_{zt} K_d V^2$

$q = .00256 K_z (1.09)(.85)(V_{ult})$

$= 25.85 K_z$

$= 25.85 (.85) = 21.98$ psf

$= 25.85 (.90) = 23.27$ psf

$= 25.85 (.94) = 24.30$ psf

$= 25.85 (.98) = 25.34$ psf

$= 25.85 (1.0) = 25.85$ psf

$V = 110$ mph Risk Category II Exposure C

$K_z = .85$ $h = 0-15$

$= .90$ $h = 20'$ ← AVG HT.

$= .94$ $h = 25'$

$= .98$ $h = 30'$

$= 1.0$ $h = 33'$

$q_h = 25.85 (.90) = 23.27$ psf $h = 20'-0"$

G_f = GUST (WINDWARD)

$= .85$ I_{bc} = 1.0 (LEEWARD)

$= .7$ (SIDE WALL)

$G = .85$

$GC_{pi} = +/- .18$

$K_z = .90$

$K_{zt} = 1.0$

WINDWARD:

21.98 (.85)(.18) (23.27)(.18) = 10.76 psf

23.27 (.85)(.18) = (23.27)(.18) = 11.64 psf

24.30 (.85)(.18) (23.27)(.18) = 12.34 psf

25.34 (.85)(.18) - (23.27)(.18) = 13.04 psf

25.85 (.85)(.18) - (23.27)(.18) = 13.39 psf

LEE WARD

(23.27)(.85)(-.5) (23.27)(.18) = -14.08 psf

TOTAL LOADS

0-15	10.76	+ 14.08	= 24.84 psf	x .6	=	14.90 psf
20'	11.64	+ 14.08	= 25.72 psf	x .6	=	15.43 psf
25'	12.34	+ 14.08	= 26.42 psf	x .6	=	15.85 psf
30'	13.04	+ 14.08	= 27.12 psf	x .6	=	16.27 psf
33'	13.39	+ 14.08	= 27.47 psf	x .6	=	16.48 psf

USE P_f = 20 psf

UNREDUCED WIND LOADS EQUIVALENT

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COMPONENTS & CLADDING LOADS

$P = q_h [GC_p - (GC_{pi})]$ WHERE $q_h = 23.27$ PSF

$GC_{pi} = \pm .18$

$GC_p = -3.2$ ZONE 3 $A \leq 10$ FT.^{2}

$= -1.4$ ZONE 3 $A > 500$ FT.^{2}

$= +.3$ ZONE 3 $A \leq 10$ FT.^{2}

$= +.2$ ZONE 3 $A > 100$ FT.^{2}

$= -1.4$ ZONE 5 $A \leq 10$ FT.^{2}

$= -.8$ ZONE 4,5 $A > 500$ FT.^{2}

$= +1.0$ ZONE 4,5 $A \leq 10$ FT.^{2}

$= +.7$ ZONE 4,5 $A > 500$ FT.^{2}

FOR TYPICAL WALL STUD NOT SUPPORTING BRICK (NOTE: WAINSCOAT BRICK DOES NOT COUNT)

$l_{max} = 18'\text{-}0"$

$A_{TRIB} = (18)(18/3) = 108$ FT.^{2} $\Rightarrow GC_{pi} = -1.05, +.18$

$P = 23.27 [-1.05 - .18] = 28.62$ PSF $\times .6 = 17.17$ PSF $\approx$ USE 20 PSF

$M = (1.33)(.020)(18)^2/8 = 1.07^{k\text{-}ft} \times 12 = 12.92^{k\text{-}in} < M_{ALL} = 30.7^{k\text{-}in}$ OK FOR (6" D_p - 16 GA. "CSJ" STUDS @ 16" OC)

$\Delta = \frac{(1.33)(.020)}{12}(5)(18\times12)^4/384EI = 2.16/I$

FOR $\Delta_{max} = l/360 = (18)(12)/360 = .6"$ $\Rightarrow I_R = 2.16/.6 = 3.61$ IN.^{2}

USING 0.70 DEFLECTION REDUCTION FACTOR FOR C&C WIND LOADS $I_R = 3.61 \times .70 = 2.52$ IN.^{4}

FOR 6" D_p - 16 GA "CSJ" STUDS $I_x = 2.86$ IN.^{2} $\Rightarrow \Delta = (2.16 \times .7)/2.86 = .528" \Rightarrow \frac{(18)(12)}{.528} = l/408$ OK

USE 6" D_p - 16 GA. "CSJ" STUDS @ 16" OC

FOR TYPICAL WALL STUD SUPPORTING BRICK

$l_{max} = 15'\text{-}0"$

$A_{TRIB} = (15)(15/3) = 75$ FT.^{2} $\Rightarrow GC_{pi} = -1.1, +.85$

$P = 23.27 [-1.1 - .18] = 29.78 \times .6 = 17.87$ PSF $\approx$ USE 20 PSF

$M = (1.33)(.020)(15)^2/8 = .748^{k\text{-}ft} \times 12 = 8.9^{k\text{-}in} < 30.7^{k\text{-}in}$ OK FOR 6" D_p - 16 GA. "CSJ" STUDS @ 16" OC

$\Delta = \frac{(1.33)(.020)}{12}(5)(15\times12)^4/384EI = 1.04/I = 1.04/2.86 = .365" \Rightarrow \frac{(15)(12)}{.365} = l/492$

IF CONSIDER 0.7 REDUCTION FACTOR FOR C&C LOAD $\Delta = .365" \times .70 = .255" \Rightarrow \frac{(15)(12)}{.255} = l/704$ OK

(NOTE: ALL OF THE ABOVE CALCS USE CONSERV $P_f = 20$ PSF WHEN ACTUAL LOAD IS LESS)

USE 6" D_p - 16 GA. CSJ STUDS @ 16" OC

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* FOR ALL ROOF JSTS (EXCEPT 10K1)

$l_{MIN} = 21.5'$

$A_{TRIB} = (21.5)(21.5/3) = 154\ Ft.^2 \Rightarrow -2.0$

$P = 23.27\ [-2.0 - .18] = 50.72\ psf \times .6 = 30.43\ psf$

$DL = 15\ psf$

NET UPLIFT = $30.43\ psf - (15)(.6) = 21.43\ psf$ ≈ USE 20psf –(SINCE ACTUAL ROOF HT IS CONSERV)

* FOR 10K1 JSTS

$l = 11'-7''$

$A_{TRIB} = (11.58)(11.58/3) = 45\ Ft.^2$ $GC_{pi} = -2.5$

$P = 23.27\ [-2.5 - .18] = 62.36 \times .6 = 37.41\ psf$

NET UPLIFT = $37.41\ psf - (15)(.6) = 28.4\ psf$ = USE 30psf

* FOR MAX DOWNFORCE

$l_{min} = 11'-7''$

$A_{TRIB} = 45\ Ft.^2 \Rightarrow GC_{pi} = +.25$

$P = 23.27\ [+.25 + .18] = 10\ psf \times .6 = 6\ psf$

FROM LOAD COMBS. $.75L_R + .75W = .75(20\ psf\ min) + .75(6\ psf) = 19.5\ psf < 20\ psf$ ∴ JUST USE NORMAL LL = 25 PSF

012

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ROOF JST DESIGN:

DL = 30 PSF
LL = 30 PSF
} USE 60 PSF TOTAL

MAX JST SPACING = 5'-0" OC

$w_{TL} = (5)(.060) = .300^{k}/_{FT}$

$w_{LL} = (5)(.030) = .150^{k}/_{FT}$

ℓ = 36'-10"

USE 26K7 JSTS

$w_{ALL} = 325\#/_{FT} > 300\#/_{FT}$ OK

$w_{LL} = 224\#/_{FT} > 150\#/_{FT}$ OK

ℓ = 25'-3"

USE 16K3 JSTS

$w_{ALL} = 301\#/_{FT} > 300\#/_{FT}$ OK

$w_{LL} = 209\#/_{FT} > 150\#/_{FT}$ OK

ℓ = 21'-6"

USE 16K2 JSTS

$w_{ALL} = 318\#/_{FT} > 300\#/_{FT}$ OK

$w_{LL} = 238\#/_{FT} > 150\#/_{FT}$ OK

ℓ = 11'-7"

USE 10K1 JST

$w_{ALL} = 550\#/_{FT} > 300\#/_{FT}$ OK

$w_{LL} = 491\#/_{FT} > 150\#/_{FT}$ OK

ℓ = 28'-8"

USE 22K4 JST

$w_{ALL} = 332\#/_{FT} > 300\#/_{FT}$ OK

$w_{LL} = 251\#/_{FT} > 150\#/_{FT}$ OK

ℓ = 32'-9"

USE 22K6 JST

$w_{ALL} = 311\#/_{FT} > 300\#/_{FT}$ OK

$w_{LL} = 204\#/_{FT} > 150\#/_{FT}$ OK

ℓ = 25'-3"

USE 20K3 JST

$w_{ALL} = 322\#/_{FT} > 300\#/_{FT}$ OK

$w_{LL} = 258\#/_{FT} > 150\#/_{FT}$ OK

LATERAL DESIGN

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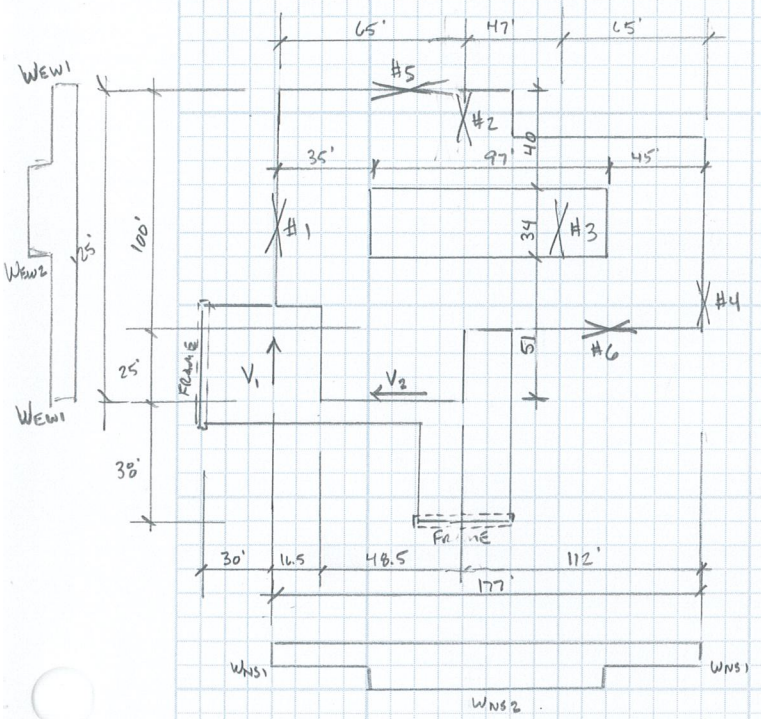
LATERAL LOADS: $h_{eve} = 18'-0"$ $h_{parapet} = 22'-0"$



$P_f = 20$ psf (SEE PREVIOUS CALC)

$q_{parapet} = 25.85 K_z$ WITH $K_z = .92$ (EL = 22'-0")

$= 25.85(.92) = 23.78$ psf

$GC_{pn} = +1.5$; -1.0

$P = 23.78(1.5) = 35.67 \times .6 = 21.40$ psf

$= 23.78(-1.0) = -23.78 \times .6 = -14.27$ psf

TOTAL PARAPET $P_p = 21.40 + 14.27$

$= 35.67$ psf (@ PARAPET)

SEISMIC LOAD: $V = .029 W$

[** NOTE: USE RF DL = 15 psf TO RESIST UPLIFT / OVERTURN LOADS TYPICAL FOR ALL BRACES]

DETERMINE W:

$W = (.025)(22850 \text{ ft}^2) = 571$ kips (ROOF DL (USE DL = 25 psf))

$= (18/2+4)(610)(.010) = 79.3$ kips (TYP. EXT. WALL)

$= (13.5)(77)(.095) = 98.7$ kips (AVE ADD'L WT. OF MECH YARD)

$= (18/2)(.040)(5+5+4+13+2+10+7+10+4) = 21.6$ kips

$= (18/2)(.040)(32+5+17+19+8) = 29.1$ kips

$W_{TOTAL} = 799.7$ kips ≈ 800 kips

(BY INSPECTION, SEISMIC LOADS ARE SMALL & WIND LOADS (BELOW) WILL CONTROL)

$V = .029 W = .029(800) = 23.2$ kips $\times .7 = 16.23$ kips $\rightarrow$ $V_{EW} = 16.23/125' = .13^k/ft$; $V_{NS} = 16.23^k/177' = .092^k/ft$

WIND LOADS:

CONSEN TO ADD IN ADDITION TO PARAPET (WHICH SHIELDS SCREEN SOME)

$w_{NS1} = (18/2)(.020) + (4)(.03567) = .322^k/ft$

$w_{NS2} = (18/2)(.020) + (4)(.03567) + .382^k/ft = .705^k/ft$

$w_{EW1} = (18/2)(.020) + (4)(.03567) = .322^k/ft$

$w_{EW2} = (18/2)(.020) + (4)(.03567) + .382^k/ft = .705^k/ft$

$V_1 = (29.5/2)(.060^k/ft) = .885$ kips

$V_2 = (38/2)(.060^k/ft) = 1.14$ kips

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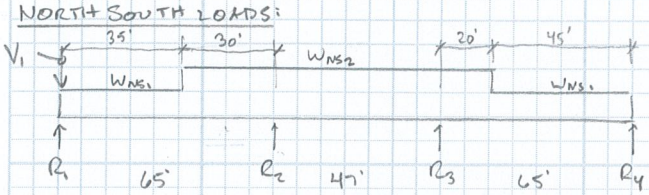
NORTH SOUTH LOADS:



$W_{NS1} = .322^k/ft$

$W_{NS2} = .705^k/ft$

$V_1 = .885$ kips

{RISA: NORTHSOUTHDIAPHRAGM.R2D}

$R_1 = 10.80^k \rightarrow (35)(.322)\left(47.5/65\right) + (.705)(30)(15/65) + .885 =$ 14 kips ← LOAD TO BRACE #1

$R_2 =$ 39.74^k ← LOAD TO BRACE #2

$R_3 =$ 35.38^k ← LOAD TO BRACE #3

$R_4 = 9.03^k \rightarrow (20)(.705)(10/65) + (45)(.322)(42.5/65) =$ 11.64 kips ← LOAD TO BRACE #4

DIAPHRAGM SHEARS:

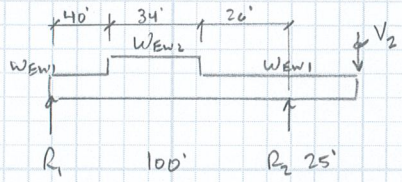
BRACE #1: $V = 14^k / (28.67 + 11.58) =$ 347 PLF

BRACE #2: $V = 39.74^k / (28.67 + 21.41 + 25.25) =$ 528 PLF

BRACE #3: $V = 35.38^k / (21.5 + 28.67 + 32.75) =$ 427 PLF

BRACE #4 $V = 11.64^k / (28.67 + 21.5 + 2) =$ 351 PLF

EAST WEST LOADS:



$W_{EW1} = .322^k/ft$

$W_{EW2} = .705^k/ft$

$V_2 = 1.14$ kips

{RISA: EAST WEST DIAPHRAGM.R2D}

$R_1 = 20.41$ kips $\rightarrow (.322)(40)(80/100) + (.705)(34)(43/100) + (.322)(26)(13/100) =$ 21.7^k ← LOAD TO BRACE #5

$R_2 =$ 34 kips $\rightarrow (.322)(40)(20/100) + (.705)(34)(57/100) + (.322)(26)(87/100) + (.322)(25) + 1.14 =$ 32.7^k

34 kips ← LOAD TO BRACE #6

DIAPHRAGM SHEARS:

BRACE #5: $V = 21.7^k /$ 50'-0" $=$ 434 PLF

← NO SPLICE TRANSFER REQ'D.

BRACE #6: $V = 34^k /$ 63'-0" $=$ 539 PLF

← NO SPLICE TRANSFER REQ'D.

USE 1½" Dp - 22 GA. WIDE RIB ROOF DECK
W/ 5/8" ϕ PUDDLE WELDS IN 36/7 PATTERN
& (6) #10 TEK-SCREWS SIDELAP
FAST. / PER SPAN
FOR ℓ = 5'-0"
$V_{allow} = 580$ PLF > 539 PLF OK

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* SIZE DRAG STRUT CONNECTIONS: BASED ON V_{max} = .539 klf ← CONSERV SINCE V_{AVE} = 580 plf

BRACE #2:

D-6: R = 39.74^k - (25.25)(.539) = 26.1^k ≈ USE 30 kips

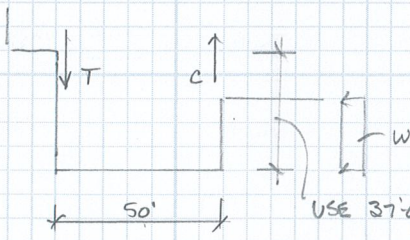
D-5: R = 39.74^k - (25.25 + 21.41)(.539) = 14.5^k ≈ USE 20 kips

BRACE #3:

F-5: R = 35.38^k - (28.67)(.539) = 19.92^k $\left(\frac{32.75}{32.75+21.5}\right)$ = 12.02^k ≈ USE 15 kips

F-4: R = 35.38^k - (28.67)(.539) = 19.92^k $\left(\frac{21.5}{32.75+21.5}\right)$ = 7.89^k ≈ USE 10 kips

CHECK DIAPHRAGM SOUTH OF GRID "3" TO CANTILEVER SOUTH



USE 37'-0" CANT. DIM CONSERV.

$M = (.322)(37)^2/2 = 220^{k\text{-}ft}$

$T = C = 220^{k\text{-}ft} / 50'\text{-}0'' = 4.4^{kips}$ ≈ USE 10 kips (@ B-3.5 AND D.1-3.5)

$V = 4.4^{kips} / 11.58' = 380$ plf < 539 plf OK

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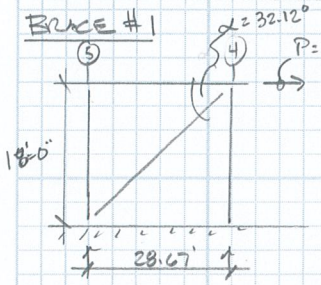
BRACES & OVERTURNING:

BRACE #1



$P_B = 14^k / \cos 32.12° = 16.5^k$ = USE 20^k

$\ell_{brace} = 33.85'$ = USE $KL = 34'-0"$

USE HSS 6x6x5/16" $P_{AN} = 33^k > 16.5^k$ OK

CHECK OVERTURNING: (.6D+W) $M_{OT} = (14)(18) = 252^{k\text{-}ft}$

@ GRID "5":

$P_{DL} = (37.16)(.5)(25)(.015) = 6.96^{kips}$

$M_R = (6.96)(28.67)(.6) = 119.8^{k\text{-}ft}$

$UPLIFT = (252 - 119.8)/28.67' = 4.61^{kips}/4\,BOLTS = 1.15^k/BOLT < 15^k/BOLT$

OK FOR 1" ϕ A36 BOLTS x 3'-0" Lg.

$DL_{req'd} = 4.61/.6 = 7.68^{kips}$

USE 5'-0" x 5'-0" x 2'-8" Dp FTG $DL = (5)^2(2.67)(.150) = 10.0^k > 7.68^k$ OK

CHECK BASE PL 13x13x1¼"

$M_R = (4.61/2)(2") = 4.61^{k\text{-}in.}$

$S_{PL} = 9(1.25)^2/6 = 2.34\,in.^3$

$f_b = 4.61^{k\text{-}in}/2.34 = 1.96\,ksi < 27\,ksi$ OK

@ GRID 4"

$P_{DL} = (37.16)(.5)(20.125)(.015) = 5.6^{kips}$

$M_R = (5.6)(28.67)(.6) = 96.5^{k\text{-}ft}$

$UPLIFT = (252 - 96.5)/28.67 = 5.42^{kips}/6\,BOLTS = .904^k/BOLT < 15^k/BOLT$

OK FOR 1" ϕ A36 BOLTS x 3'-0" Lg.

$SHEAR: 14^k/6\,BOLTS = 2.33^k/BOLT < 7.8^k/BOLT$

$COMBINED: (2.33/7.8) + (.904/15) = .36 \le 1.0$ OK

$DL_{req'd} = 5.42/.6 = 9.03^k < DL = 10.0^k$ ← 5'-0" ϕ FT

∴ USE 5'-0" x 5'-0" x 2'-8" FTG

CHECK DOWNFORCE: $\Delta P = 252/28.67 = \pm 8.78^{kips}$

(D+L+W)

@ GRID "5" $P_{D+L+W} = 27.87^k + 8.78^{kips} = 36.65^{kips}$ ← CONTROLS

@ GRID "4" $P_{D+L+W} = 22.3^k + 8.78^{kips} = 31.08^{kips}$

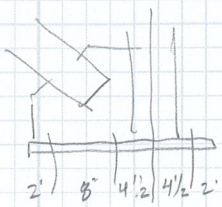
FOR KL = 17'-0" USE HSS 5x5x¼"

$P_{AN} = 60^k > 36.65^k$ OK

$FTG = 36.65^k/(5)^2 = 1.46\,ksf < 2.5\,ksf$ OK

SUMMARY: GRID "5", GRID "4" } USE HSS 5x5x¼" w/ 5'-0" ϕ x 2'-8" Dp FTG

13x13x1¼" w/ (4) 1" ϕ A36 x 3'-0" Lg.



1½" x 10 x 21 BASER w/ (6) 1" ϕ A36 x 3'-0" Lg.

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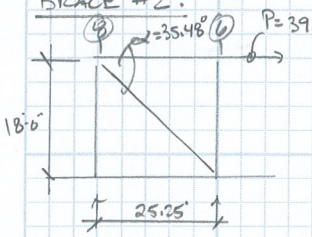
BRACE #2:



$P_B = 39.74 / \cos 35.48° = 48.8^k \Rightarrow$ USE 55^k

$\ell_{brace} = 31'-0"$ USE $Kl = 31'-0"$

USE HSS 7x7x5/16" BRACE $P_{AL} = 64.5^k > 48.8^k$ OK

CHECK OVERTURNING: (1.6D+W)

$M_{OT} = (39.74)(18) = 715.3^{k\text{-ft}}$

@ GRID "8":

$P_{DL} = (28+15.75)(.5)(25.25)(.5)(.015) = 4.14^k$

$M_R = (4.14)(25.25)(.6) = 62.76^{k\text{-ft}}$

UPLIFT: $(715.3 - 62.76)/25.25' = 25.8^{kips}/6\text{BOLTS} = 4.3^k/\text{BOLT} < 15^k/\text{BOLT}$ (OK FOR 1" ϕ A36 x 3'-0" Lg. ABs) — SEE BRACE #5 CALCS

$DL_{REQ'D} = 25.8^k/.6 = 43^k$

USE 10'-0" ϕ x 2'-8" D ϕ FTG: $DL = (10)^2(2.67)(.150) = 40^{kips}$; $= (10)^2(.5)(.100) = 5^{kips}$ } $45^k > 43^k$ OK

@ GRID "6" $P_{DL} = (23.33)(14)(.015) = 4.89^k$

$(23.33)(15.75)(.015)(14.95/22.83) + (14.37)(7.08)(.015)(3.54/22.83) = 3.88^k$ } 8.77^k

$M_R = (8.77)(25.25)(.6) = 132^{k\text{-ft}}$

UPLIFT $= (715.3-132)/25.25' = 23.07^{kips}/6\text{BOLTS} = 3.84^k/\text{BOLT} < 15^k/\text{BOLT}$ (OK FOR 1" ϕ BOLTS A36)

SHEAR $= 39.74^k/6\text{BOLTS} = 6.62^{kips}/\text{BLT} < 12.1^k \leftarrow$ USE 1 1/4" ϕ BOLTS OK

COMBINED TENSION/SHEAR

$(3.84/23.4) + (6.62/12.1) = .71 \leq 1.0$ OK USE 1 1/4" ϕ x 3'-0" Lg. ABS

$DL_{REQ'D} = 23.07/.6 = 38.45^k \leftarrow$ USE 10'-0" ϕ x 2'-6" FTG

$DL = (10)^2(2.67)(.150) = 40^k > 38.45^k$ OK

CHECK DOWN FORCE: (D+L+W)

$\Delta P = 715.3^{k\text{-ft}}/25.25' = \pm 28.32^{kips}$

SEE BRACE #5 FOR BASE PL & ABs

@ GRID "8" $P = 36.26^k + 9.62^k + 28.32^{kips} = 64.2^{kips}$

FROM UNITY CHECK (FOR $Kl = 18'-0"$ & $M = 53.67^{k\text{-ft}}$ FROM BASE CANOPY CALC)

{EXCEL: ASTEEL — BRACE.XLS} UNITY CHECK = .95 ≤ 1.0 OK

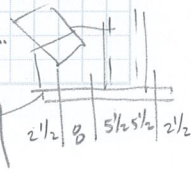
USE HSS 12x8x3/8" FOR ADDED CAPACITY UNITY = .80 ≤ 1.0 OK

FTG $= 64.2^k/(10)^2 = 642\ psf < 2.5\ ksf$ OK

@ GRID "6": $P = 41.2^{kips} + 28.32^{kips} = 69.5^{kips} \Rightarrow$ FOR $Kl = 17'-0"$ USE HSS 6x6x1/4"

$P_{AL} = 94^k > 69.5^k$ OK

USE 1 1/2 x 10" x 24" BASE PL w/ (4) 1 1/4" ϕ A36 x 3'-0" Lg. ABs



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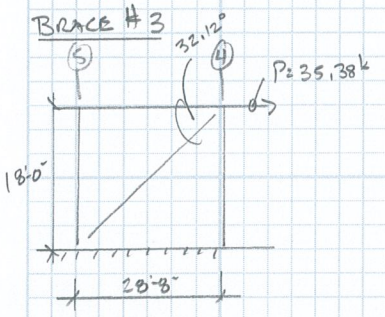
BRACE #3



$P_B = 35.38^k / \cos 32.12° = 41.77^k \Rightarrow$ USE 50^k

$\ell_{brace} = 33.85' \Rightarrow$ USE $K\ell = 34'-0"$

USE HSS 7x7x3/8" BRACE $P_{AN} = 62^k > 41.77^k$ OK

CHECK OVERTURNING: (.6D+W)

$M_{OT} = (35.38)(18) = 636.84^{k\text{-}ft}$

@ GRID 5:

$P_{DL} = 25.9^{kips}$ (FROM RISA)

$M_R = (25.9)(28.67)(.6) = 445^{k\text{-}ft}$

UPLIFT $= (636.84 - 445)/28.67' = 6.67^{kips}/6\text{ BOLTS} = 1.11^{kips} < 23.4^{kips}$ (OK FOR 1¼" ϕ BOLTS)

SHEAR: $35.38^k/6\text{ BOLTS} = 5.89^{kips} < 12.1^{k}/\text{BOLT}$ OK FOR (6) 1¼" ϕ BOLTS

COMBINED: $(5.89/12.1) + (1.11/23.4) = .53 \le 1.0$ OK

$DL_{REQ'D} = 6.67^k/1.6 = 11.1^{kips}$ ← USE 6'-0" ϕ x 2'-8" D_P FTG:

$DL = (6)^2(2.67)(.150) = 14.4^k > 11.1^k$ OK

@ GRID 4:

$P_{DL} = 15.64^k$ (FROM RISA)

$M_R = (15.64)(28.67)(.6) = 269^{k\text{-}ft}$

UPLIFT $= (636.84 - 269)/28.67 = 12.82^{kips}/4\text{ BOLTS} = 3.2^{kips} < 15^{k}/\text{BOLT}$ (OK FOR 1" ϕ BOLTS)

SHEAR = 0

$DL_{REQ'D} = 12.82/.6 = 21.36$ kips

USE 7'-0" x 7'-0" x 2'-8" D_P FTG: $DL = (7)^2(2.67)(.150) = 19.62^k$

$= (7)^2(1.00)(.150) = 4.9^k$ } $24.5^k > 21.36^k$ OK

CHECK BASE R FOR 14x14x1¼"

$M_R = (12.82^k/2)(2") = 12.82^{k\text{-}in.}$

$S_R = \frac{10}{6}(1.25)^2 = 2.60\ in^3$ } $f_b = 4.92\ ksi < 27\ ksi$ OK

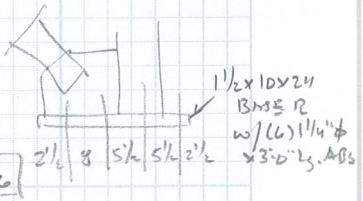
CHECK DOWN FORCE: (.9D+1.6W)

$\Delta P = 636.84/28.67 = \pm 22.2^k$

@ GRID "5" $P = 83.6^k$ (RISA) $+ 22.2^k = 105.8^{kips}$

FOR $K\ell = 17'-0"$ USE HSS 6x6x5/16" $P_{AN} = 113^k > 105.8^k$

FTG: $105.8/(7)^2 = 2.15\ ksf < 2.5\ ksf$ USE 7'-0" ϕ x 2'-8" D_P FTG

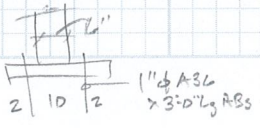


@ GRID "4" $P = 56.8^k$ (RISA) $+ 22.2^k = 79^k$

FOR $\ell = 17'-0"$ USE HSS 6x6x1/4" $P_{AN} = 94^k > 79^k$ OK

FTG: $56.8^k/(7)^2 = 1.15\ ksf < 2.5\ ksf$ OK

FOR 14x14 BASE R $t_{min} = .97"$ USE 1¼" THK BASE R



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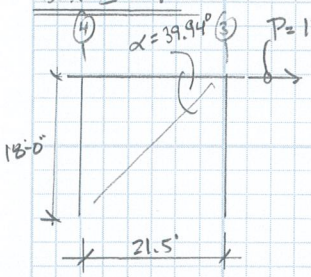
BRACE #4



$P_{BRACE} = 11.64^k / \cos 39.94° = 15.18^k \Rightarrow$ USE 20^k

ℓ_{brace}: 28'-0" USE $K\ell$ = 28'-0"

USE HSS 6x6x3/16" BRACE $P_{AL} = 31^k > 15.18^k$ OK

CHECK OVERTURNING (.6D+W)

$M_{OT} = (11.64)(18) = 209.5^{k\text{-ft}}$

@ GRID "4":

$P_{DL} = (28.67 + 21.5)(.5)(15.16)(.015) = 5.70^k$

$M_R = (5.70)(21.5)(.6) = 73.5^{k\text{-ft}}$

UPLIFT $= (209.5 - 73.5)/21.5' = 6.32^k / 6 \text{ BOLTS} = 1.05^k/\text{BOLT} < 15^k/\text{BOLT}$ OK FOR 1"ϕ A36 BOLTS x 3'-0" lg.

SHEAR $= 11.64^k / 6 \text{ BOLTS} = 1.94^k/\text{BOLT} < 7.8^k/\text{BOLT}$ OK FOR (6) 1"ϕ x 3'-0" lg. A36 BOLTS

COMBINED: $(1.94/7.8) + (1.05/15^k) = .32 \le 1.0$ OK

$DL_{REQ} = 6.32^k / .6 = 10.53^{kips}$

FOR 5'-0" x 5'-0" x 2'-8" FTG $DL = (5)^2(2.67)(.150) = 10.0^{kips}$

$(5)^2(.5)(.100) = 1.25^{kips}$ SLAB ATOP

$11.26^k > 10.53^k$ OK

USE 5'-0" x 5'-0" x 2'-8" Dp FTG

@ GRID "3"

$P_{DL} = [(21.5)(.5) + 2](15.16)(.015) = 2.9^{kips}$

$M_R = (2.9)(21.5)(.6) = 37.4^{k\text{-ft}}$

UPLIFT $= (209.5 - 37.4)/21.5' = 8 \text{ kips} / 4 \text{ BOLTS} = 2^k/\text{BOLT} < 15^{kips}$ OK FOR 1"ϕ A36 BOLTS x 3'-0" lg.

OK

SHEAR = 0

$DL_{REQ} = 8/.6 = 13.33 \text{ kips}$

USE 6'-0" x 6'-0" x 2'-8" FTG: $DL = (6)^2(2.67)(.150) = 14.4^k > 13.33^k$ OK

DOWNFORCE: (D+L+W)

$\Delta P = 209.5/21.5' = \pm 9.74^k$

@ GRID "4": $P_{DL+LL} = 22.74^k + 9.74^k = 32.5^{kips} \leftarrow$ USE HSS 5x5x1/4" (@ $K\ell$ = 17'-0")

$P_{ALL} = 60^k > 32.5^k$ OK

FTG: $32.5^k / (5)^2 = 1.29 \text{ ksf} < 2.5 \text{ ksf}$ OK

BY INSPECTION USE SAME BASE PL AS USED FOR BRACE #1

@ GRID "3" $P_{DL} = 11.66^k + 9.74^k = 21.4^{kips} \leftarrow$ USE HSS 5x5x1/4" (@ $K\ell$ = 17'-0")

$P_{ALL} = 60^k > 21.4^k$ OK

FTG: $21.4 / (6)^2 = 594 \text{ psf} < 2500 \text{ psf}$

OK

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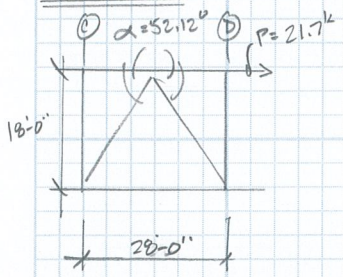
BRACE #5



$P_B = \left[21.7^k/2\right] / \cos 52.12° = 17.67^k$ ≈ (USE 25k)

$\ell_{brace} = 22.80'$ ≈ (USE KL = 23'-0")

USE HSS 6x6x3/16" BRACES $P_{nc} = 47^k > 17.67^k$ OK

CHECK OVERTURNING: $M_{OT} = (21.7)(18) = 390.6^{k\text{-ft}}$

(.6D+W)

@ GRID "C" $P_{DL} = (37.16 + 27.91)(.5)(25.25)(.5)(.015) = 6.16^{kips}$

$M_{RES} = (6.16)(28)(.6) = 103.5^{k\text{-ft}}$

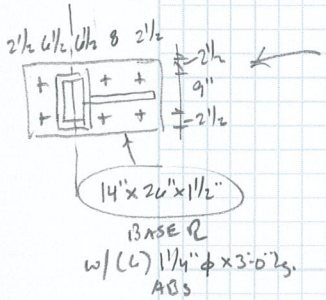
UPLIFT $= (390.6 - 103.5)/28'\text{-}0" = 10.25^{kips}/6\ \text{BOLTS} = 1.71^k/\text{BOLT} < 23.4^k/\text{BOLT}$ OK FOR 1 1/4" ϕ BOLTS

SHEAR $= \left[21.7^k/2\right]/6\ \text{BOLTS} = 1.80^{kips} < 12.1^k$ OK FOR 1 1/4" ϕ BOLTS

COMBINED: $(1.8/12.1) + (1.71/23.4) = .22 \le 1.0$ OK

$DL_{REQ'D} = 10.25^k/.6 = 17.08^{kips}$

USE 7'-0" x 7'-0" x 2'-8" Dp FTG $DL = (7)^2(2.67)(.150) = 19.62^k > 17.08^k$ OK



@ GRID "D" $P_{DL} = 4.14$ (FROM BRACE #2 CALC)

$M_{DL} = (4.14)(28)(.6) = 69.5^{k\text{-ft}}$

UPLIFT $= (390.6 - 69.5)/28'\text{-}0" = 11.46^{kips}/6\ \text{BOLTS} = 1.91^k/\text{BOLTS} < 23.4^k/\text{BOLT}$ OK FOR 1 1/4" ϕ BOLTS

SHEAR $= \left[21.7/2\right]/6\ \text{BOLTS} = 1.80\ \text{kips} < 12.1\ \text{kips/BOLTS}$ OK FOR 1 1/4" ϕ BOLTS

COMBINED: $(1.91/23.4) + (1.80/12.1) = .23 \le 1.0$ OK

$DL_{REQ} = 11.46/.6 = 19.1^k$

FOR 10'-0" ϕ FTG (FROM BRACE #2) $DL = (10)^2(2.67)(.150) = 40\ \text{kips} > 19.1^k$ OK

USE 10'-0" ϕ FTG PER BRACE #2 CALCS

DOWNFORCE: (D+.6W) $\Delta P = 390.6/28'\text{-}0" = \pm 13.95^k$

@ GRID "C": $P_{DL+LL} = 34.7^k + 6.14^k + 13.95^k = 54.8^k$

FROM UNITY CHECK (FOR KL = 18'-0" & M = 53.67 k-ft FROM CANOPY CALCS)

{EXCEL: ASTEEL-BRACE2.XLS} UNITY CHECK = .90 ≤ 1.0

↑ USE HSS 12x8x3/8 FOR ADDED CAPACITY UNITY = .76 ≤ 1.0 OK

FTG = $54.8^k/(7)^2 = 1.11\ \text{KSF} < 2.5\ \text{KSF}$ OK

@ GRID "D" $P_{DL+LL} = 26.26^k + 9.62^k + 13.95^k = 49.83^k < 64.2^k$ ← (FROM BRACE #2 CALC)

∴ BRACE #2 LOADS CONTROL @ THIS COL.

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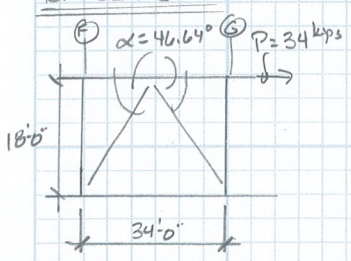
BRACE #6



$P_B = \left[34^k/2\right] / \cos 46.64° = 24.75^k$ = USE 30 kips

$\ell_{brace} = 24.75'$ = (USE KL = 25'-0")

USE HSS 6x6x3/16" BRACES $P_{AM} = 39.5^k > 24.75^k$ OK

CHECK OVERTURNING: (1.6D + W)

$M_{OT} = (34)(18) = 612^{k\text{-ft}}$

@ GRID "F" $P_{DL} = (24.5 + 34.08)(.5)(21.5)(.5)(.015) = 4.72^{kips}$

$M_R = (4.72)(34)(.6) = 96.35^{k\text{-ft}}$

UPLIFT $= (612 - 96.35)/34'-0" = 15.16^{kips}/6\ BOLTS = 2.52^k/_{BLT} < 23.4^k/_{BLT}$ OK (1 1/4" ϕ BOLTS)

SHEAR: $\left[34^k/2\ BRACES\right]/6\ BOLTS = 2.83^k/_{BLT} < 12.1^k/_{BLT}$ OK

COMBINED: $\left(2.52^k/23.4\right) + \left(2.83/12.1\right) = .34 \le 1.0$ OK

$DL_{REQ'D} = 15.16/.6 = 25.26^{kips}$

USE 8'-0" x 8'-0" x 2'-8" Dp FTGS $DL = (8)^2(2.67)(.150) = 25.63^k > 25.26$ kips OK

@ GRID "G" $P_{DL} = (34.08 + 30.33)(.5)(21.5)(.5)(.015) = 5.19^{kips}$

$M_R = (5.19)(34)(.6) = 105.9^{k\text{-ft}}$

UPLIFT $= (612 - 105.9)/34'-0" = 14.88^k/6\ BOLTS = 2.48^k/_{BOLT} < 23.4^k/_{BLT}$ OK (1 1/4" ϕ BOLTS)

SHEAR $= 2.83^k/_{BOLT}$ (SAME AS GRD "F")

COMBINED: $\left(2.83/12.1\right) + \left(2.48/23.4\right) = .34 \le 1.0$ OK

$DL_{REQ'D} = 14.88/.6 = 24.8^{kips}$ ← USE 8'-0" x 8'-0" x 2'-8" Dp FTG

DOWNFORCE: (D+L+W)

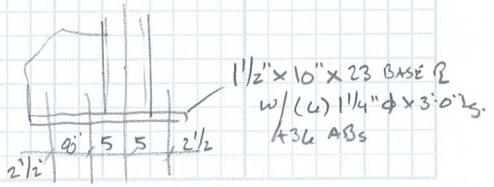
$\Delta P = 612^{k\text{-ft}}/34'-0" = \pm 18.0$ kips

@ GRID "F" $P_{DL+LL} = 23.9$

@ GRID "G" $P_{DL+LL} = 24.9^k$ ← (CONTROLS)

$P_{TOTAL} = 24.9^k + 18$ kips $= 42.9^{kips}$ → (FOR KL = 18'-0") USE HSS 5x5x1/4" $P_{ALL} = 54^k > 42.9^k$ OK

$FTG = 42.9^k/(8)^2 = 670\ psf \le 2.5$ ksf OK



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* DESIGN FTG REINF FOR 7'-0", 8'-0" & 10'-0" FTGS

* 7'-0" ⊞ FTG x 2'-8" Dp

$M_u = (1.7)(2.5)(3.5)^2/2 = 26.03^{k\text{-ft}}$

$A_s = (26.03)(12)/(28)(54) = .206\,in^2 \times 1.33 = .27\,in^2$ ← USE #5 @ 6" o.c. $A_s = .62\,in^2/ft > .27\,in^2/ft$ OK

* 8'-0" FTG x 2'-8" Dp

$M_u = (1.7)(2.5)(4)^2/2 = 34^{k\text{-ft}}$

$A_s = (34)(12)/(28)(54) = .269\,in^2 \times 1.33 = .358\,in^2$ ← USE #5 @ 6" o.c. $A_s = .62\,in^2/ft > .358\,in^2/ft$ OK

* 10'-0" FTG x 2'-8" Dp

$M_u = (1.7)(2.5)(5)^2/2 = 53.125^{k\text{-ft}}$

$A_s = (53.125)(12)/(28)(54) = .421 \times 1.33 = .56\,in^2$ ← USE #6 @ 6" o.c. $A_s = .88\,in^2/ft > .56\,in^2/ft$ OK

GRAVITY MEMBER DESIGN
(Includes Rooftop Screens)

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MECHANICAL YARD BMS/JSTS

AHU-1: MAX-WT. = 15,000# → 100"x411" → $15{,}000^{\#} / \frac{(100)(411)}{144} = 52.55$ psf = USE 55 psf

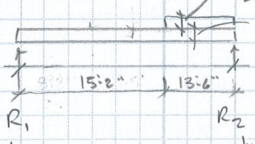
AHU-2: MAX WT. = 19,000# → 100"x360" → $19{,}000^{\#} / \frac{(100)(360)}{144} = 76$ psf = USE 75 psf ← (CONTROLS)

AHU	75 psf
SLAB: 4" SLAB: 2½ LT. WT. CONC ON 1½" Dp - 22 GA. COMP DECK	30 psf
SDL:	20 psf
LIVE LOAD	30 psf
	155 psf

ADD 95 psf TO TYPICAL RF LOAD

TYP. MECH YD. BM:

ℓ = 28'-8"



{RISA: TYPMECHBM.R2D}

.3 k/ft ADD FOR MECH

$R_1 = 5.81^k / 5'\text{-}0" = 1.16^k/ft$ (.73 k/ft DL, .43 k/ft LL)

$R_2 = 9.20^k / 5'\text{-}0" = 1.84^k/ft$ (1.41 k/ft DL, .43 k/ft LL)

.198 k/ft ADD FOR MECH

M = 54.6 x 12 = 655.2 k-in.

V = 9.204k ← NOTE SHEAR EXCEEDS KCSJST CAPACITY (I.E. 22KCS5JST $V_{allow} = 8.6^k < 9.2^k$ ∴ USE WF BMS)

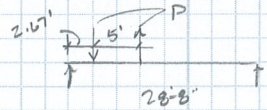
FOR W16X31 BMS

$\Delta = .722" = \ell/476$ OK

$\Delta_{LL} = .21" = \ell/1641$ OK

USE W16X31 BMS

ADD SCREEN LOADS:



P = 5.35k

M = 59.4 k-ft $S_e = (59.4)(12)/30 = 23.76 in^3 < 47.2 in^2$ OK

$\Delta = .181" \Rightarrow \ell/425$ OK

$R_1 = 5.97^k$

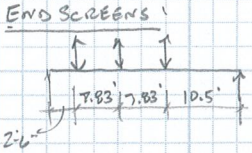
$R_2 = 9.37^k$

IF USE W16X36 @ SCREEN LOCATIONS

$\Delta = .677" \Rightarrow \ell/508$ OK

USE W16X36 @ THESE LOCATIONS

END SCREENS:



FOR W16X36

M = 98.68 k-ft $S_e = (98.68)(12)/30 = 39.4 in^3 < 56.5 in^3$ OK

$\Delta = 1.1" \Rightarrow \ell/313$ OK

$\Delta_{LL} = .67" \Rightarrow \ell/513$ OK

USE W16X36 @ THESE LOCATIONS

MODEL IN AS ADDED LIVE LOAD

3.8k

$R_1 = 9.61^k$ (9.61k - 5.81)

$R_2 = 16.37^k$ (16.37k - 9.20)

7.17k

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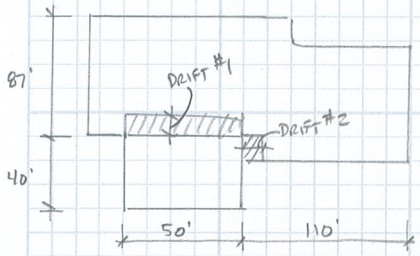
DRIFT LOAD ANALYSIS @ TRANSITION BTWN HIGH/LOW RF



DRIFT #1:

(LEE) $l_u = 40'$ $h_d = .43\sqrt[3]{40}\sqrt[4]{20+10} - 1.5 \sqrt{1.0} = 1.94'$

(WIND) $l_u = 87'$ $h_d = .43\sqrt[3]{87}\sqrt[4]{20+10} - 1.5 \sqrt{1.0} \times .75 = 2.21'$ ← (CONTROLS)

$\gamma = (.13)(20) + 14 = 16.6$ PSF

$P_d = (2.21')(16.6) = 36.84$ PSF

$w = (4)(2.21) = 8.84'$

DESIGN 10K1 FOR $^{DL}30 + {}^{LL}35$ PSF = 65 PSF

$w = (5)(65) = 325$ PLF < 550 #/FT OK

DRIFT #2:

(LEE) $l_u = 50'$ $h_d = .43\sqrt[3]{50}\sqrt[4]{20+10} - 1.5 = 2.21'$

(WIND) $l_u = 110'$ $h_d = .43\sqrt[3]{110}\sqrt[4]{20+10} - 1.5 \times .75 = 2.49'$ ← (CONTROLS)

$P_d = (2.49)(16.6) = 41.35$ PSF

$w = (4)(2.49) = 9.96'$

IF USE 30 PSF DL + 30 PSF LL

DRIFT LOAD = $\frac{41.35 - (30-14)}{25.35}$ 25.35

$w = (25.35/41.35)(9.96') = 6.10'$

ADDITION LOAD FOR DRIFT = $(2.67+5)(.5)(25.35) = 97$ PLF

BASE LOAD = $(2.67+5)(.5)(60\text{ PSF}) = 230$ PLF

327 PLF

FOR 16K3 JST $W_{ALL} = 301$ #/FT < 327 #/FT

NOT OK SO ADD ADDITIONAL JST

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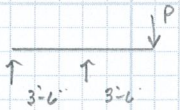
MAIN ROOF FRAMING:

HIGH ROOF AREA:

* OUTRIGGERS:



$P = (1.75)(3)(.060) = .315^k$
$= (1.5+1.5)(.010)(3) = .09^k$
$\} .405^k \left(\begin{matrix} .248^k \text{ DL} \\ .158^k \text{ LL}\end{matrix}\right)$

$M = (.405^k)(3.5) = 1.42^{k\text{-ft}}$

$S_{req} = (1.42)(12)/(.6)(46) = .616 \text{ in.}^3 < 1.30 \text{ in.}^3$ OK FOR HSS 2½ dia x ¼"

$\Delta = (.405^k)(42)^2(84)/3EI = .689/I = .689/1.63 = .42" \Rightarrow (3.5)(12)(2)/.42 = \ell/198$

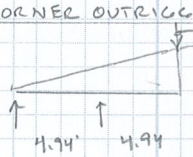
IF USE HSS 2½x2½x5/16" & USE DL+LL = 50 PSF $P = (50/60)(.315) + .09 = .3525^k$

$\Delta = (.3525/.405)(.689/I) = .6/I = .6/1.83 = .327" \Rightarrow (42)(2)/.327 = \ell/256$ OK

$\Delta_{LL} = (.131/.3525)(.327) = .127" \Rightarrow 84/.127 = \ell/689$ OK

USE HSS 2½x2½x5/16" @ 36" OC

CORNER OUTRIGGER



$w = (3.5)(.050) = .175^k/\text{FT}$ $\left(\begin{matrix} .0875^k \text{ DL} \\ .0875^k \text{ LL}\end{matrix}\right)$

$P = (1.75)(3.5)(.050) + (1.5+1.5)(.010)(7) = .388^k$ $\left(\begin{matrix} .298^k \\ .363^k \text{ DL} \\ .153^k \text{ LL} \\ .089^k\end{matrix}\right)$
$(.25) + (1.75)(3.5)(.5)(.66)(.050)$

{RISA: OUTRIGGER .R2D}

FOR HSS 4x2½x3/8" $\Delta_{TL} = .6" \Rightarrow (4.94)(12)(2)/.6" = \ell/197$

$\Delta_{LL} = .6" - .395" = .208" \Rightarrow \ell/570$ OK

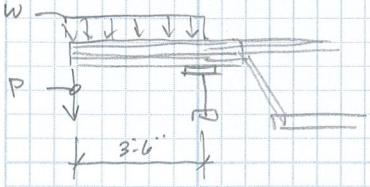
(NOTE TL = 50 PSF IS CONSERVATIVE)

USE HSS 4x2½x3/8" OUTRIGGER

* DESIGN JST EXTENDED ENDLOADS

$w = (5)(.060) = 300^{\#}/\text{FT}$ (USE 150 PLF DL, 150 PLF LL)

$P = (1.5+1.5)(.010)(5) = 150^{\#}$



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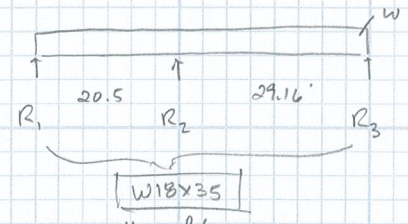
* BM @ GRIDLINE "1"



W18X35

$w_{DL} = (18.5+3.5)(.030) = .66^{k/ft} + [(1.5+1.5)(.010) = .09^{k/ft}] = .75^{k/ft}$

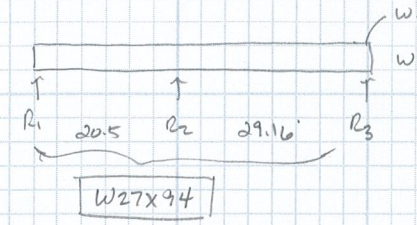
$w_{LL} = (18.5+3.5)(.030) = .66^{k/ft}$

{RISA: RF BM GRIDLINE 1.R2D}

$R_1 = 10.93^k$ (14.5^k)
$R_2 = 45.9^k$
$R_3 = 17.4^k$ (20.55^k)

$\Delta_1 = .151" = \ell/1628$ OK
$\Delta_2 = .94" = \ell/372$ OK

* BM @ GRIDLINE "3.5" (B TO D.1)



W27X94

$w_{DL} = (24.5)(.030) = .735^{k/ft} + (4)(.010) = .040^{k/ft} = .775^{k/ft}$

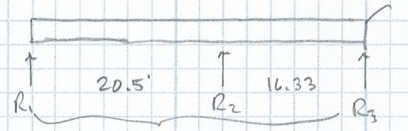
$w_{LL} = (24.5)(.030) = .735^{k/ft}$ [+ (11.58)(.5)(.005) = $.029^{k/ft}$ DRIFT] = $.764^{k/ft}$

{RISA: RF BM GRIDLINE 3.5 - B TO D-1.R2D}

$R_1 = 12.46^k$ (15.77^k)
$R_2 = 51.7^k$
$R_3 = 19.76^k$ (22.44^k)

$\Delta_1 = .028"$ $\ell/8889$ OK
$\Delta_2 = .168"$ $\ell/2084$ OK

* BM @ GRIDLINE "B" (HIGH RF)



W24X55 ← (SIZED TO FACILITATE AXIAL LOAD CONN @ COL B-3.5)

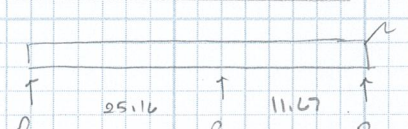
$w = (5.25)(.060) + (3)(.010) = .345^{k/ft}$ ($.1875^{k/ft}$ DL, $.1575^{k/ft}$ LL)

{RISA: RF BM GRIDLINE B.R2D}

$R_1 = 3.37^k$ (3.53^k)
$R_2 = 9.26^k$
$R_3 = 2.49^k$ (2.81^k)

$\Delta_1 = .024"$
$\Delta_2 = .007"$
} Δ's ARE SMALL

* BM @ GRIDLINE D.1 (HIGH RF)



W24X55 ← (SIZED TO FACILITATE AXIAL LOAD CONN. @ COL D.1-3.5 AND TO CONNECT LOW RF ALONG GRID D.1 BTWN 2.3 & 3.5)

w = (SAME LOADS AS GRIDLINE B)

{RISA: RF BM GRIDLINE D-1.R2D}

$R_1 = 4.15^k$ (4.34^k)
$R_2 = 10.27^k$
$R_3 = 1.06^k$ (2.01^k)

$\Delta_1 = .054"$
$\Delta_2 = .006"$
} Δ's ARE SMALL

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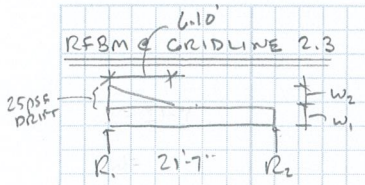
RFBM @ GRIDLINE 2.3



$w_1 = (23.25)(.5)(.060) = .70^{k}/_{ft}$

$w_2 = (23.25)(.5)(.025) = .29^{k}/_{ft}$

$M_A = 42.9^{k\text{-}ft}$

$f_b = 17.73\ ksi < 38\ ksi$ OK

$\Delta = .626" \Rightarrow {}^{l}/_{413}$ OK

{RISA: RFBMGRID2-3.R2D}

$R_1 = 8.59^{k}$

$R_2 = 7.87^{k}$

FOR W14X22:

USE W14X22

RFBM @ GRID 3.5 (A.2 TO B)

$l = 16.67'$

$w = (11.58)(.5)(.065) = .376^{k}/_{ft}$

$M = (.376)(11.58)^2/_{8} = 6.3^{k\text{-}ft}$ $S_R = (6.3)(12)/_{30} = 2.52\ in.^3 < 29\ in^3$ OK

$R_1 = 2.17^{k}$

$R_2 = 2.17^{k}$

BY INSPECTION W14X22 OK

TYPICAL BM PARALLEL TO BAR JST:

$l = 28.67'$

$w = (5)(.060) = .3^{k}/_{ft}$

$M_A = (.3)(28.67)^2/_{8} = 30.82^{k\text{-}ft}$ $S_R = (30.82^{k\text{-}ft})(12)/30 = 12.32\ in.^3 < 38.4\ in^3$ OK

$\Delta = ({}^{.3}/_{12})(5)(28.67 \times 12)^4/_{384EI} = {}^{157}/_{301} = .522" \Rightarrow (28.67)(12)/.522" = {}^{l}/_{658}$ OK

USE W16X26

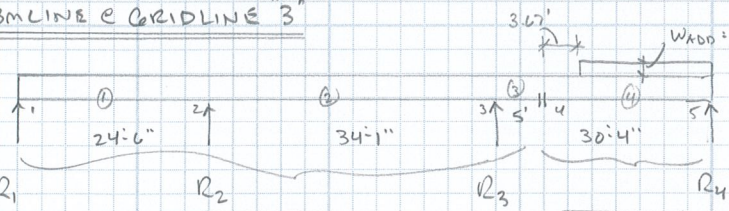
$l = 32'\text{-}9"$; $w = .3^{k}/_{ft}$

$M_A = (.3)(32.75)^2/_{8} = 40.22^{k\text{-}ft}$ $S_R = (40.22)(12)/30 = 16.08 < 47.2\ in^2$ OK

$\Delta = ({}^{.3}/_{12})(5)(32.75 \times 12)^4/_{384EI} = {}^{267}/_{I} = {}^{267}/_{301} = .89" \Rightarrow {}^{l}/_{441}$ OK

$= {}^{267}/_{375} = .712" \Rightarrow {}^{l}/_{551}$ OK ← (USE W16X31 FOR BETTER DEFL CONTROL)

RFBM LINE @ GRIDLINE "3"



{RISA: RFBMGRIDLINE 3.R2D}

$w_{DL} = (21.5)(.5)(.030) = .3225^{k}/_{ft}$

$w_{LL} = (21.5)(.5)(.030) = .3225^{k}/_{ft}$

$R_1 = 6.82^{k}$ (7.90^{k})

$R_2 = 23.9^{k}$

$R_3 = 24.9^{k}$

$R_4 = 10.3^{k}$ (11.66^{k})

$\Delta_1 = .302 \Rightarrow {}^{l}/_{973}$ OK

$\Delta_2 = .987" \Rightarrow {}^{l}/_{460}$ OK

$\Delta_{3\,CANT} = .333" \Rightarrow (60)(2)/.333 = {}^{l}/_{360}$ OK

$\Delta_4 = .841" \Rightarrow (30.33)(12)/.841" = {}^{l}/_{432}$ OK

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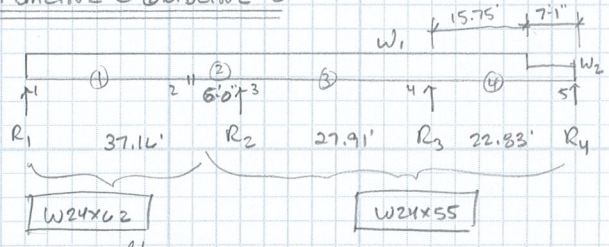
RFBM LINE @ GRIDLINE "6"



{RISA: RFBM GRIDLINE 6.R2D}

$w_{1DL} = (23.5)(.030) = .705^k/ft$

$w_{1LL} = (23.5)(.030) = .705^k/ft$

$w_{2DL} = (16.5)(.030) = .495^k/ft$

$w_{2LL} = (16.5)(.030) = .495^k/ft$

$R_1 = 22.93^k$ (26.2^k)

$R_2 = 56.1^k$

$R_3 = 41.2^k$

$R_4 = 12.6^k$ (13.2^k)

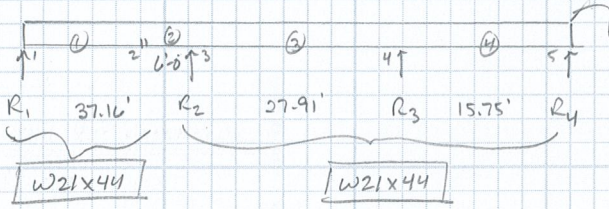
$\Delta_1 = .891" = \ell/500$ OK

$\Delta_{2\,Const} = .373" = \frac{(6)(12)(2)}{.373} = \ell/386$ OK

$\Delta_3 = .181" = \ell/1850$ OK

$\Delta_4 = .162" = \ell/1691$ OK

RFBM LINE @ GRIDLINE "8"



{RISA: RFBM GRIDLINE 8.R2D}

$w_{DL} = (12.62)(.030) = .379^k/ft$

$w_{LL} = (12.62)(.030) = .379^k/ft$

$R_1 = 12.5^k$ (14.08^k)

$R_2 = 30.78^k$

$R_3 = 20.14^k$

$R_4 = 5.86^k$ (5.92^k)

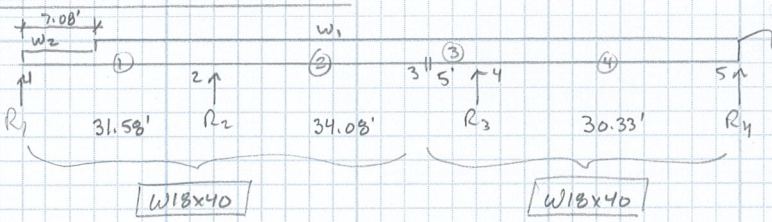
$\Delta_1 = .85" = \ell/524$ OK

$\Delta_{2\,Const} = .293" = \ell/491$ OK

$\Delta_3 = .151" = \ell/2218$ OK

$\Delta_4 = .038" = \ell/4972$ OK

RFBM LINE @ GRIDLINE "7"



{RISA: RFBM GRIDLINE 7.R2D}

$w_{1DL} = (32.75)(.5)(.030) = .491^k/ft$

$w_{1LL} = (32.75)(.5)(.030) = .491^k/ft$

$w_{2DL} = (11.33)(.5)(.030) = .17^k/ft$

$w_{2LL} = (11.33)(.5)(.030) = .17^k/ft$

$R_1 = 9.51^k$ (11.47^k)

$R_2 = 38.1^k$

$R_3 = 35.1^k$

$R_4 = 14.5^k$ (14.89^k)

$\Delta_1 = .702" \quad \ell/540$ OK

$\Delta_2 = .563" \quad \ell/726$ OK

$\Delta_{3\,Const} = .395" = \frac{(60)(2)}{.395} = \ell/303$ OK

$\Delta_4 = .924" \Rightarrow \frac{30.33(12)}{.924} = \ell/393$ OK

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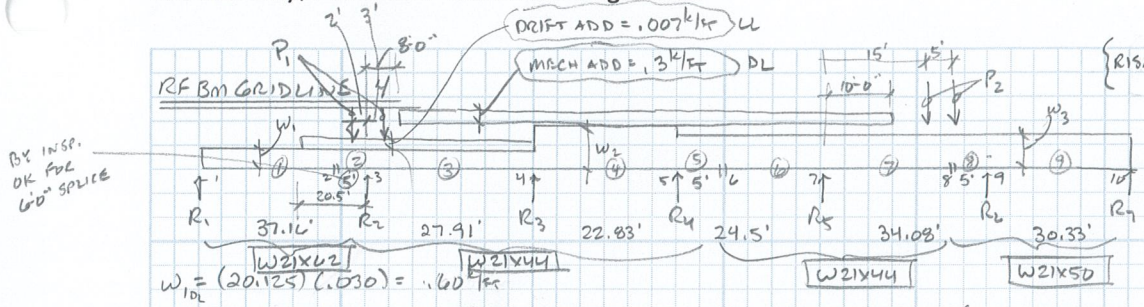
Kansas City, MO 64111 www.bdc-engrs.com

Project _____

Date _____ Page ___ of ___



{RISA: RFBMLINE GRID 4.R22D}

$R_1 = 20.32^k$ (22.3^k)
$R_2 = 49.1^k$
$R_3 = 45.9^k$ (48.84^k)
$R_4 = 45.32^k$
$R_5 = 56.8^k$
$R_6 = 52.6^k$ (55^k)
$R_7 = 21.7^k$ (22.74^k)

(CONSIDERS REVERSIBLE SCREEN LOADS)

REACTIONS CONSIDERING SCREEN LOADS

$w_{1DL} = (20.125)(.030) = .60^k/ft$

$w_{1LL} = (20.125)(.030) = .60^k/ft$

$w_{2DL} = (25.95)(.030) = .78^k/ft$

$w_{2LL} = (25.95)(.030) = .78^k/ft$

$w_{3DL} = (25.12)(.030) = .75^k/ft$

$w_{3LL} = (25.12)(.030) = .75^k/ft$

$P_1 = 5.35\left[(18.16/28.67) + (10.33/28.67) + (2.5/28.67)\right] = 5.78^k$

$P_2 = 5.35\left[(16.5/28.67) + (7/28.67) + (2/28.67)\right] = 4.75^k$

$\Delta_1 = .962"$ $\ell/463$ OK

$\Delta_{2\,CANT.} = .33"$ $\ell/363$ OK

$\Delta_3 = .262"$ $\ell/1278$ OK

$\Delta_4 = .21"$ $\ell/1304$ OK

$\Delta_{5\,CANT.} = .151"$ $\ell/794$ OK

$\Delta_6 = .184"$ $\ell/1592$ OK

$\Delta_7 = .68"$ $\ell/601$ OK

$\Delta_{8\,CANT} = .35"$ $\ell/342$ OK

$\Delta_9 = .85"$ $\ell/428$ OK

COL SIZE:

BOB D. CAMPBELL & CO.
Structural Engineers Since 1957
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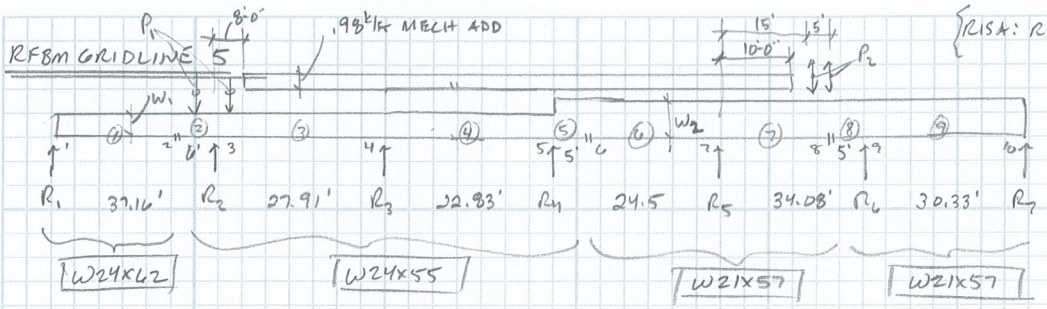
Kansas City, MO 64111 www.bdc-engrs.com

Project _____

Date _____ Page ___ of ___



{RISA: RFBMLINE GRID 5, R22D}

$R_1 = 24.3^k$ (27.87^k)
$R_2 = 66.2^k$
$R_3 = 66.4^k$ (70.6^k)
$R_4 = 65.8^k$
$R_5 = 83.6^k$
$R_6 = 64.3^k$ (68^k)
$R_7 = 26.7^k$ (27.93^k)

$W_{1DL} = (25.04)(.030) = .75^k/ft$
$W_{1LL} = (25.04)(.030) = .75^k/ft$

$W_{2DL} = (30.70)(.030) = .921^k/ft$
$W_{2LL} = (30.70)(.030) = .921^k/ft$

$P_1 = 5.35\left[\left(26.17/28.67\right) + \left(18.32/28.67\right) + \left(10.5/28.67\right)\right] = 10.26^k$
$P_2 = 5.35\left[\left(26.67/28.67\right) + \left(21.67/28.67\right) + \left(12.16/28.67\right)\right] = 11.28^k$

SINCE D+.75L+.75W THEN USE .75W

$\Delta_1 = .914"$ $\ell/487$ OK
$\Delta_{2\ CANT.} = .337"$ $\ell/427$ OK
$\Delta_3 = .277"$ $\ell/1209$ OK
$\Delta_4 = .115"$ $\ell/2382$ OK
$\Delta_{5\ CANT.} = .164"$ $\ell/731$ OK
$\Delta_6 = .208"$ $\ell/1413$ OK
$\Delta_7 = .617"$ $\ell/662$ OK
$\Delta_{8\ CANT.} = .36"$ $\ell/333$ OK
$\Delta_9 = .877"$ $\ell/415$ OK

Trane Performance Climate Changer Air Handler

Unit Overview - AHU-01

Application	Unit Size	External Dimensions			Weight	
		Height	Width	Length	Installed	Rigging
Outdoor unit	CSAA035	73.4 in	100.0 in	410.8 in	12290 lb	11381 lb
Quantity of Shipping Sections		Largest Ship Split			Heaviest Ship Split	Elevation
		Height	Width	Length		
5 piece(s)		73.5 in	100.0 in	96.0 in	3902 lb	0.00 ft

Supply Fan				Return/Exhaust Fan			
Airflow	18000 cfm	Total Static Pressure	6.131 in H2O	Airflow	18000 cfm	Total Static Pressure	2.004 in H2O

Note: Height includes air handler sloped roof panel and standing seam.

ADD 2700# CURB (EST.)

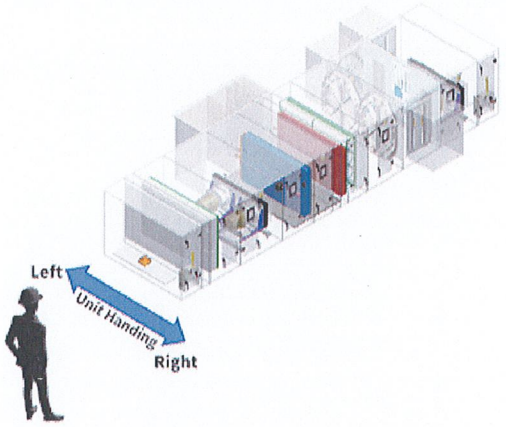
USE 15,000 #

(100)(411) / 144 = 52.55 psf

USE 55 psf

Construction Features

Panel	2in. foam injected R-13 with thermal break
Panel Material	All unit inner panels - galvanized
Integral Base Frame	6in. integral base frame
Paint	Slate gray
Short Circuit Current Rating	5 kA
Agency Approval	UL listed unit
Roof Curb Type	Standard roof curb



Unit Electrical

Circuit	Voltage/Phase/Frequency	FLA	MCA	Max Fuse Size
Circuit number 1 Return/booster fan motor(s)	460/3/60	22.00 A	24.75 A	35.00 A
Circuit number 2 Supply fan motor(s)	460/3/60	42.00 A	47.25 A	60.00 A
Circuit number 3 UV lights 1	115/1/60	2.60 A	3.25 A	15.00 A
Circuit number 4 Lights + switch	115/1/60	2.61 A	3.26 A	15.00 A
Circuit number 5 Receptacle	115/1/60	8.00 A	10.00 A	15.00 A

Unit Controls

Controller Type	No controller

Warranty

Warranty section	Extd. warranty
Parts - whole unit	2nd yr only additional
Labor - 1st year	1st year labor warranty
Labor - beyond 1st year	2nd year only

Pipe cabinet section

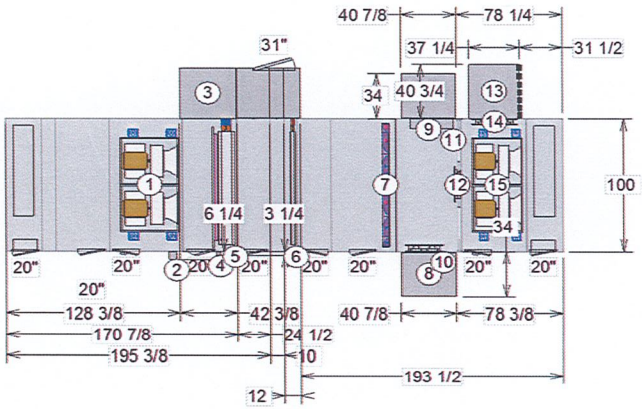
Pipe cabinet 1 side doors	One side door

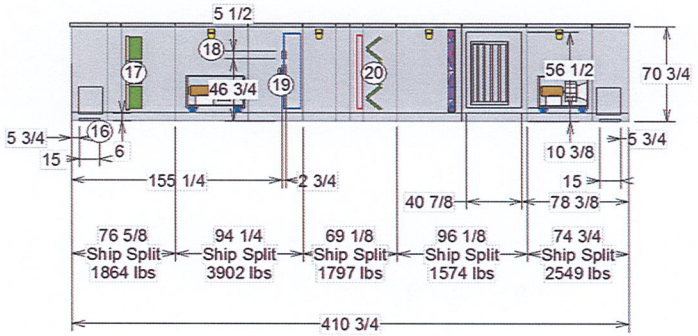
Starter/VFD only section - Position: 1

Return/Exhaust Fan Motor Interface Door	Right

Openings

Face	Path	Type	Airflow	Face Velocity	Area	Pressure Drop
Bottom Face Feature	Return	Rectangular	18000 cfm	2551 ft/min	7.06 sq ft	0.000 in H2O



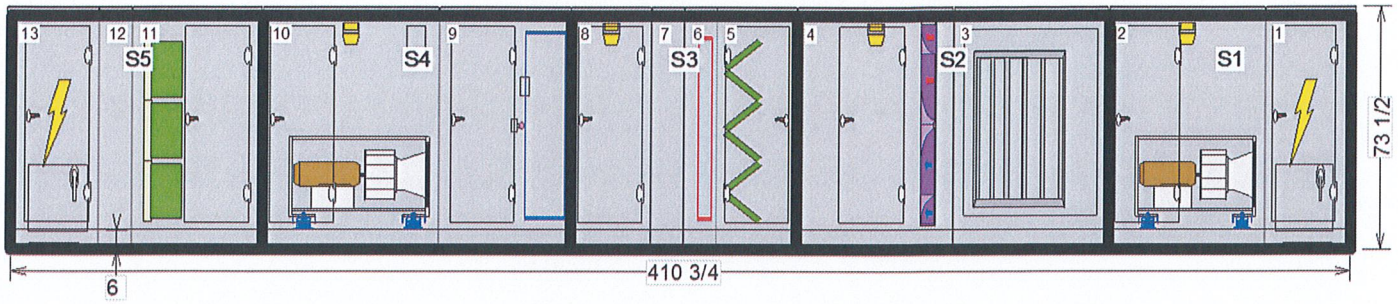


1 Plenum fan - 22.25in. dd plenum, full width, H press Supply fan 15 hp 460/3
2 Light switch and/or receptacle RH
3 Pipe cabinet left (4)
4 UV light switch RH
5 Cooling coil - 6 Rows Coil type 5/8" Shipping Coil, General (W)
6 Heating coil - 1 Rows Coil type 5/8" Shipping Coil, General (5W)
7 Air Blender
8 Hood right
9 Hood left
10 Damper right-opposed blade 48.5 x 28.5
11 Standard Traq damper left 49.75 x 32.25
12 Return air damper
13 Hood left - back air outlet
14 Damper left-opposed blade 47.5 x 34.22
15 Plenum fan - 22.25in. dd plenum, 80% width, H press Return fan 7.5 hp 460/3
16 Opening bottom 67.75 x 15
17 Front loading cartridge filters - 12in. cartridge - 95% eff - MERV 15
18 Marine light
19 UV light rack
20 Angled filters - Pleated media - MERV 8

Doors
20 width x 61 height
31 width x 59 height

For maneuvering purposes, include 1.125 inches to each ship split length for overlapping panel flange. Flange will not add to overall installed unit length shown.

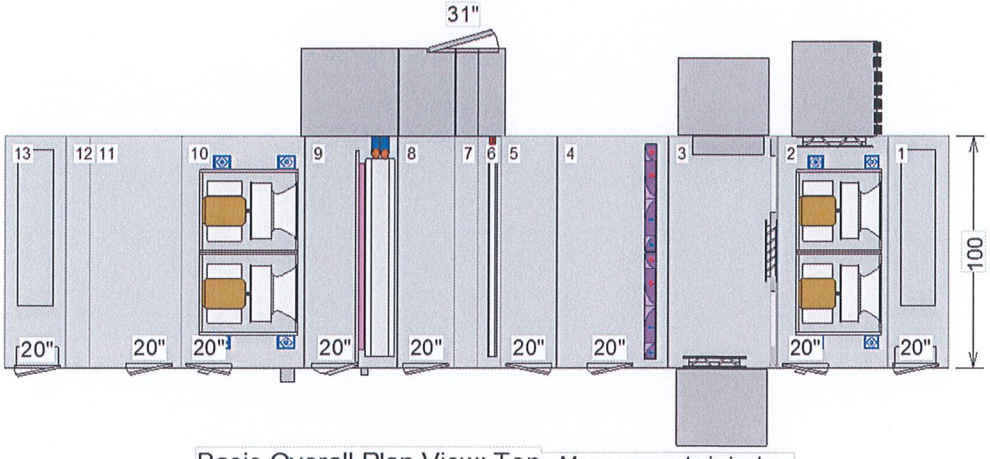
Shipping splits are indicated by thick black lines



For maneuvering purposes, include 1.125 inches to each ship split length for overlapping panel flange. Flange will not add to overall installed unit length sh

Pos #	Module	Length	Weight
1	Controls section	26 1/2	670.85
2	Fan section	48 1/4	1878.56
3	Air mixing section	48 1/8	914.48
4	Air blender	48 1/8	659.44
5	Filter section	24 5/8	631.88
6	Coil section	10	428.80
7	Access section	10	272.83
8	Access section	24 5/8	463.39
9	Coil section	40 3/8	1805.42
10	Fan section	53 3/4	2096.35
11	Filter section	40 1/8	956.25
12	Access section	10	236.73
13	Controls section	26 1/2	670.85

Module	Weight
Roof Curb	603.78
Installed Unit Weight	12289.62 lbs

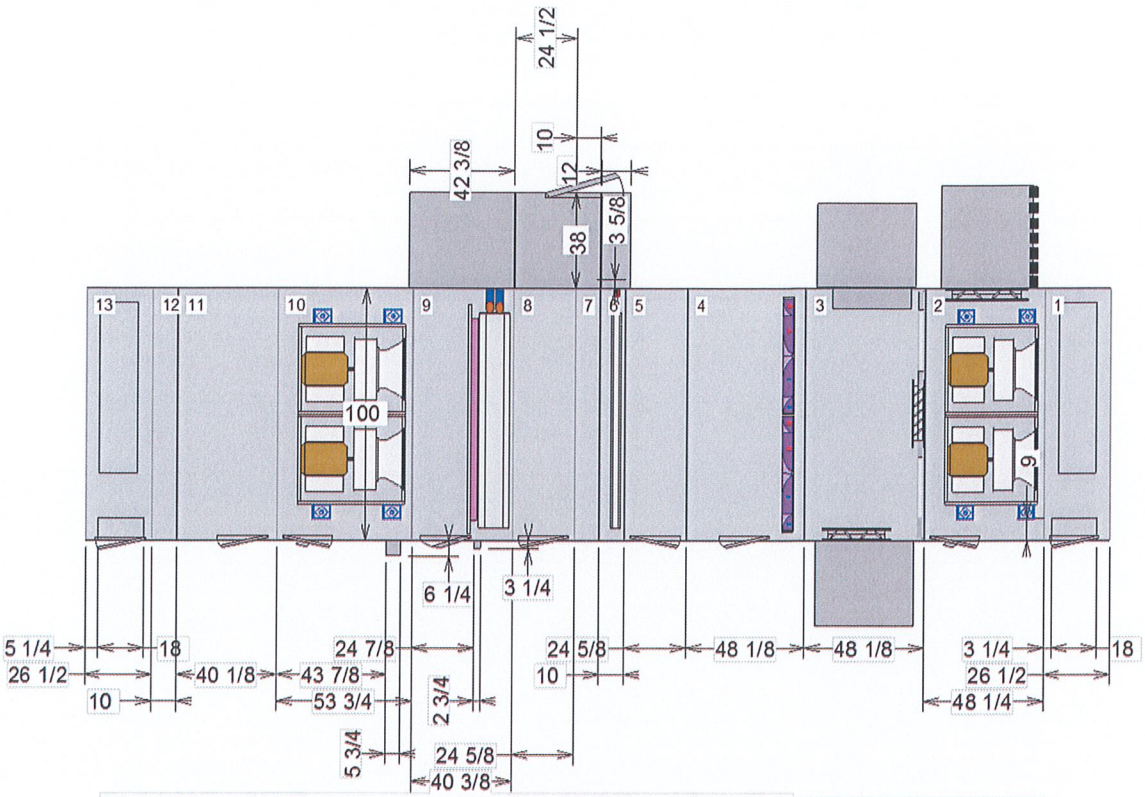


Basic Overall Plan View: Top - Measurements in inches

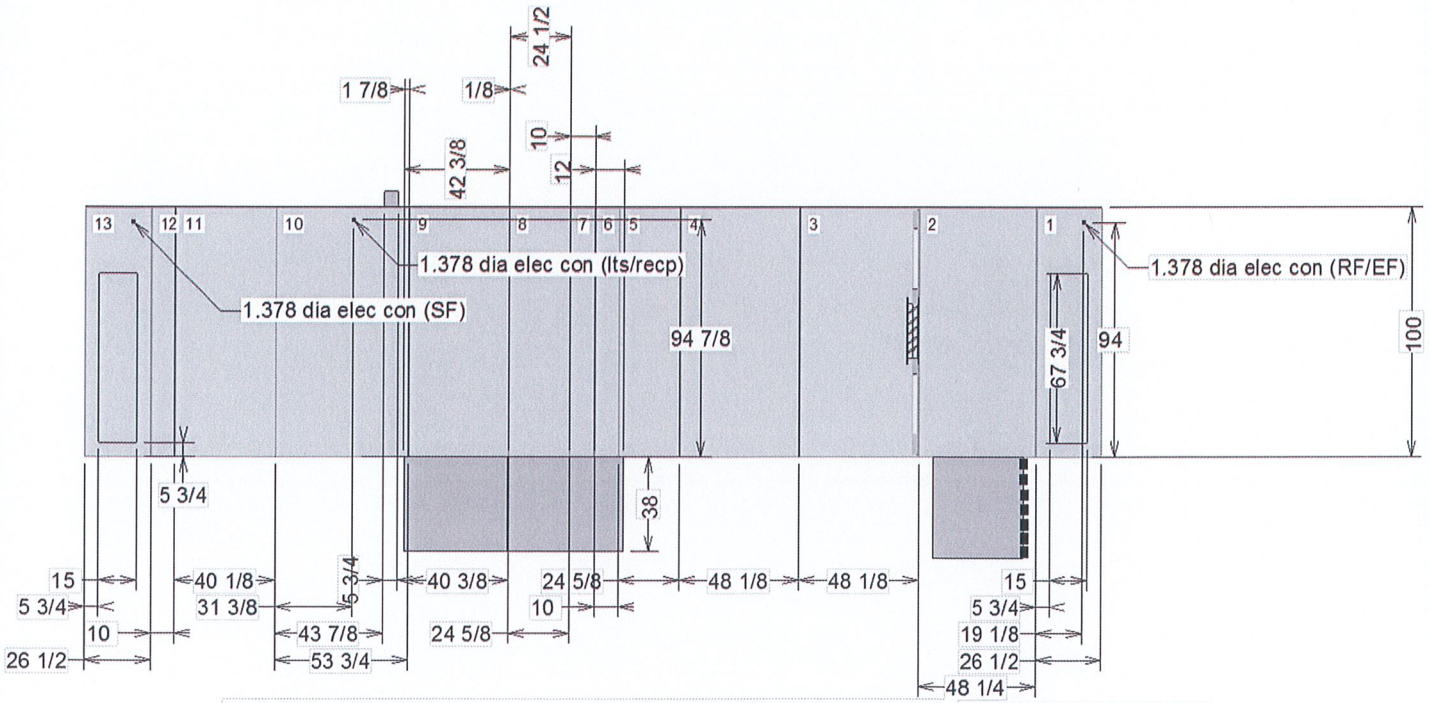
OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 18000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-01
Paint: Slate gray		Rigging weight: 11380.7 / Installed weight:

TRANE
Performance Climate Changer Air Handlers



Right Side of Unit — Detailed Plan View: Top - Measurements in inches



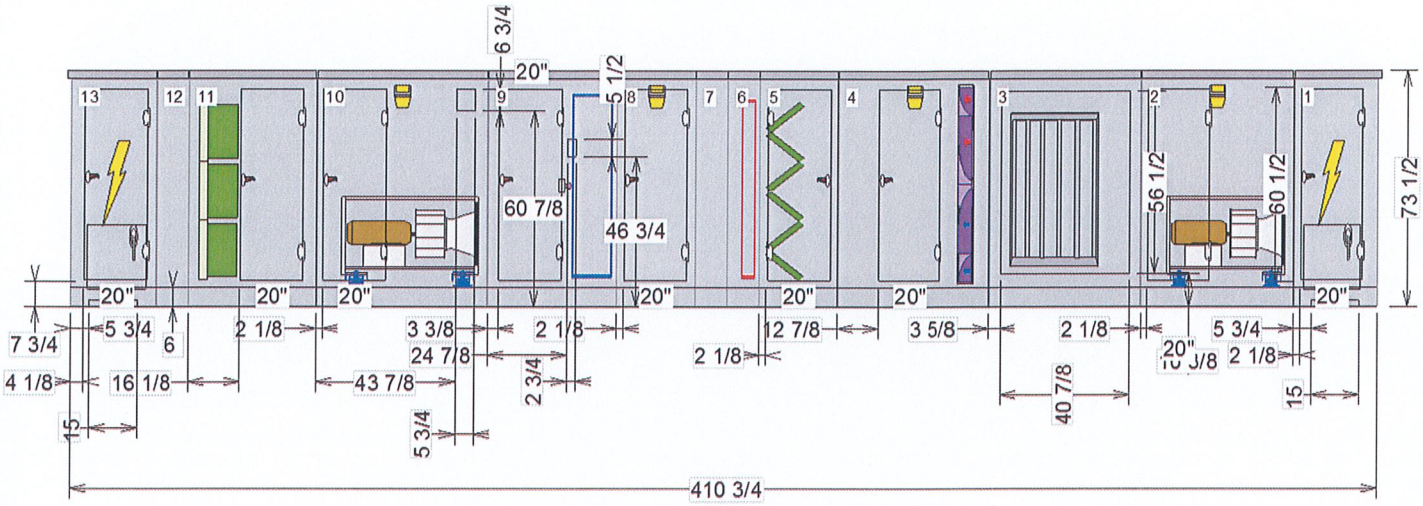
Left Side of Unit — Detailed Plan View: Bottom - Measurements in inches

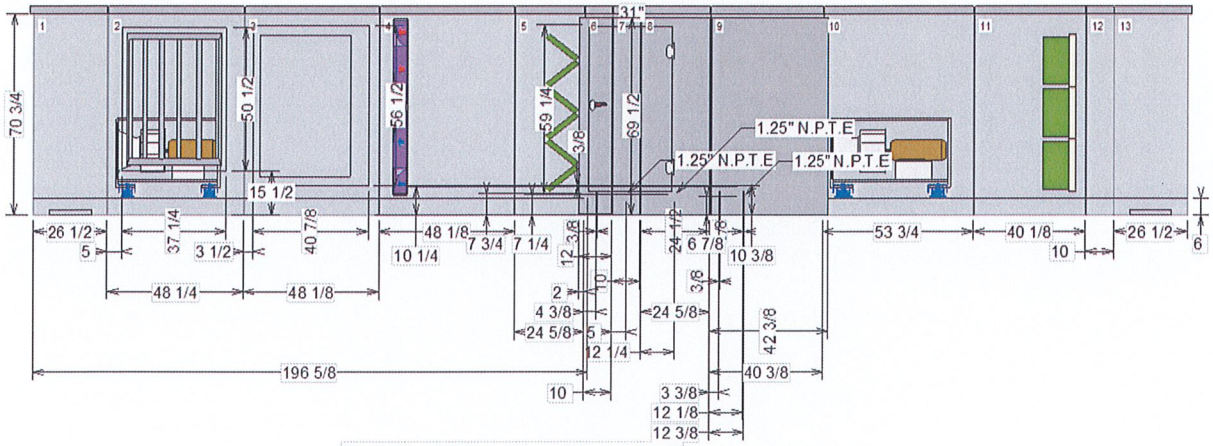
****Placement of electrical conduit may vary by a tolerance of 8" in any direction.**

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 18000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-01
Paint: Slate gray		Rigging weight: 11380.7 / Installed weight:

TRANE
Performance Climate Changer
Air Handlers



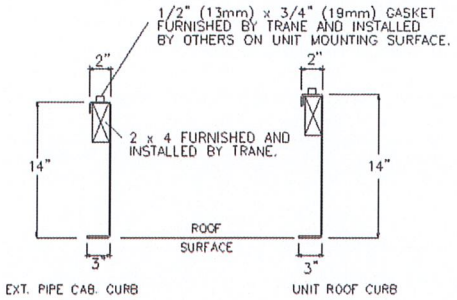


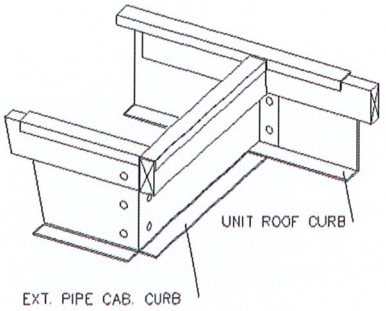
Detailed Elevation View: Left - Measurements in inches

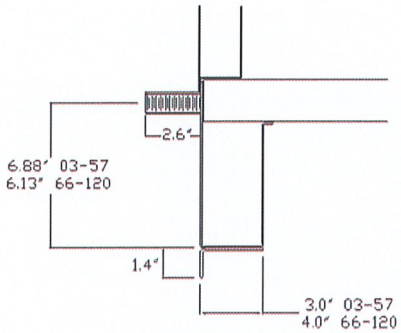
OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 18000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-01
Paint: Slate gray		Rigging weight: 11380.7 / Installed weight:

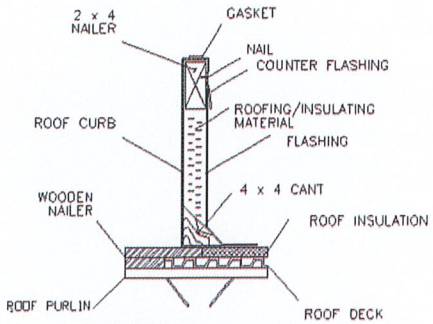
TRANE
Performance Climate Changer Air Handlers



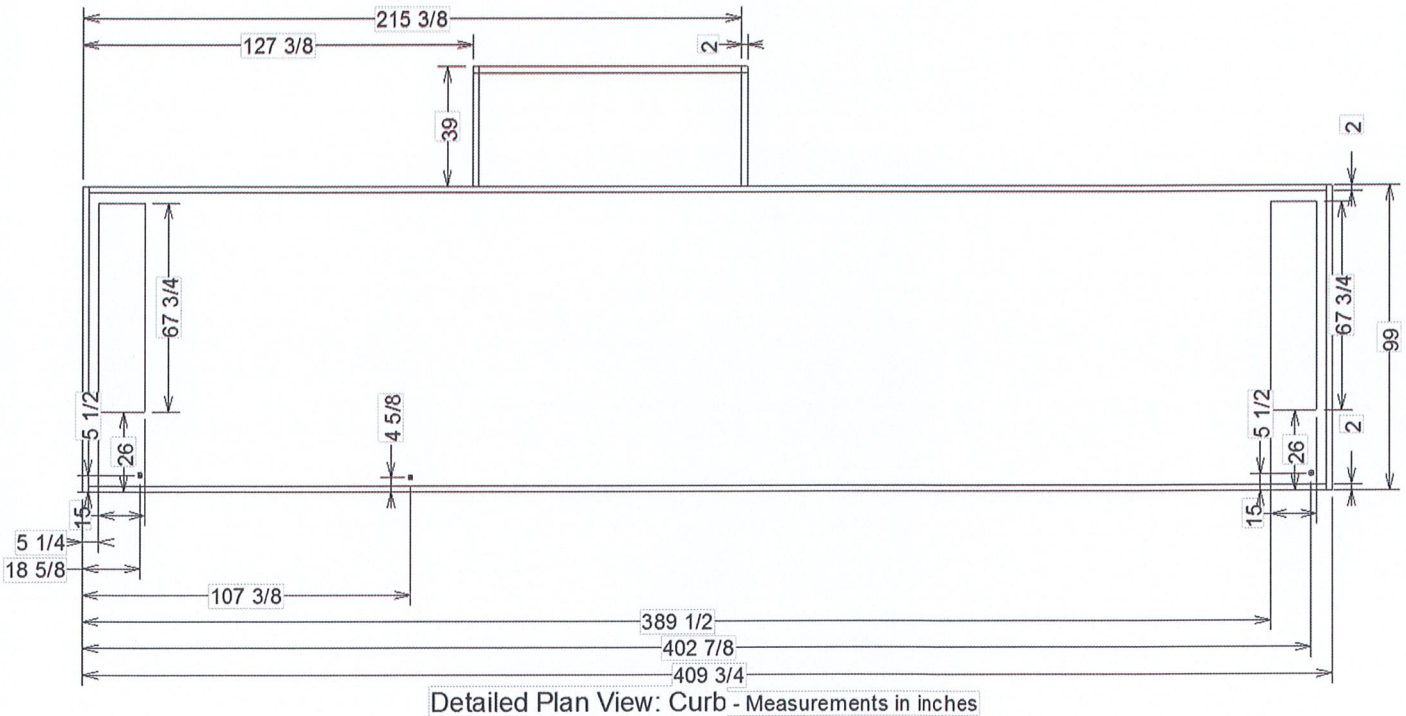




DRAIN CONNECTION



NOTE:
MATERIALS TO ATTACH ROOF CURB TO ROOF ARE TO BE SUPPLIED BY THE INSTALLER.



Detailed Plan View: Curb - Measurements in inches

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 18000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-01
Paint: Slate gray		Rigging weight: 11380.7 / Installed weight:

TRANE®
Performance Climate Changer Air Handlers

Trane Performance Climate Changer Air Handler

Unit Overview - AHU-02

Application	Unit Size	External Dimensions			Weight	
		Height	Width	Length	Installed	Rigging
Outdoor unit	CSAA035	140.9 in	100.0 in	359.5 in	16625 lb	15787 lb

Quantity of Shipping Sections	Largest Ship Split			Heaviest Ship Split	Elevation
	Height	Width	Length		
9 piece(s)	70.8 in	100.0 in	88.2 in	2654 lb	0.00 ft

Supply Fan				Return/Exhaust Fan			
Airflow	16004 cfm	Total Static Pressure	7.808 in H2O	Airflow	15000 cfm	Total Static Pressure	2.567 in H2O

Note: Height includes air handler sloped roof panel and standing seam.

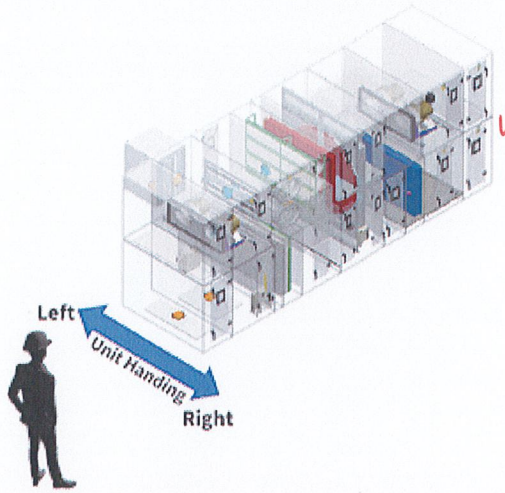
ADD ≈ 2400# CURB (EST.)

USE 19,000# / (100)(360)/144 = 76 psf

USE 75 psf

Construction Features

Panel	2in. foam injected R-13 with thermal break
Panel Material	All unit inner panels - galvanized
Integral Base Frame	6in. integral base frame
Paint	Slate gray
Short Circuit Current Rating	5 kA
Agency Approval	UL listed unit
Roof Curb Type	Standard roof curb



Unit Electrical

Circuit	Voltage/Phase/Frequency	FLA	MCA	Max Fuse Size
Circuit number 1 Return/booster fan motor(s)	460/3/60	22.00 A	24.75 A	35.00 A
Circuit number 2 Supply fan motor(s)	460/3/60	42.00 A	47.25 A	60.00 A
Circuit number 3 Cool-dry quiet	460/3/60	0.34 A	0.37 A	15.00 A
Circuit number 4 UV lights 1	115/1/60	2.60 A	3.25 A	15.00 A
Circuit number 5 Lights + switch	115/1/60	2.61 A	3.26 A	15.00 A
Circuit number 6 Receptacle	115/1/60	8.00 A	10.00 A	15.00 A

Unit Controls

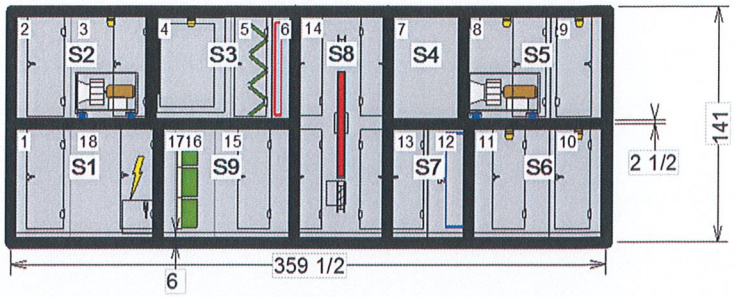
Controller Type	No controller

Warranty

Warranty section	Extd. warranty
Parts - whole unit	2nd yr only additional
Labor - 1st year	1st year labor warranty
Labor - beyond 1st year	2nd year only

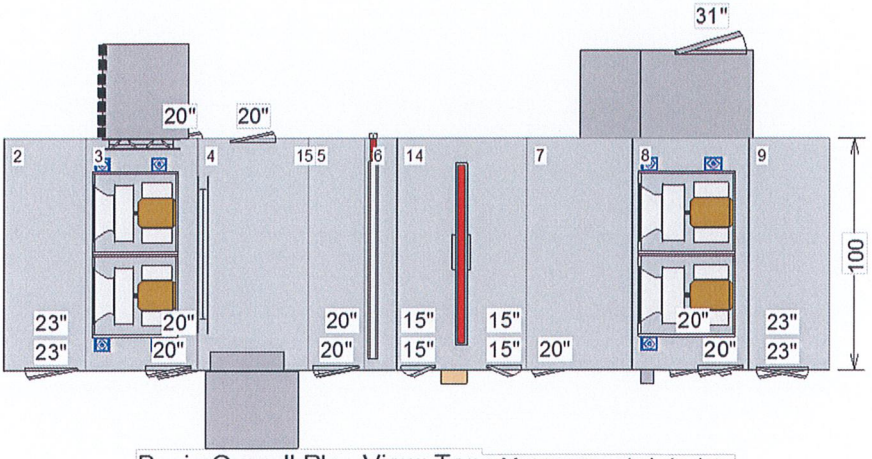
Pipe cabinet section

Pipe cabinet 1 side doors	One side door



For maneuvering purposes, include 1.125 inches to each ship split length for overlapping panel flange. Flange will not add to overall installed unit length sh

Pos #	Module	Length	Weight	Pos #	Module	Length	Weight
1	Air mixing section	35 1/2	566.02	14	Wheel	56 1/4	2618.34
2	Air mixing section	35 1/2	621.05	15	Access section	48	544.97
3	Fan section	48 1/4	1847.52	16	Filter section	24	658.58
4	Air mixing section	48 1/8	777.47	17	Access section	10 1/8	229.96
5	Filter section	24 1/2	608.34	18	Controls section	52 3/4	612.46
6	Coil section	14	398.45		Roof Curb		528.39
7	Custom length section	45 3/8	698.88			Installed Unit Weight	16624.81 lbs
8	Fan section	51 3/4	2032.94				
9	Air mixing section	35 1/2	621.05				
10	Air mixing section	35 1/2	566.02				
11	Access section	48 1/8	737.46				
12	Coil section	24 5/8	1612.38				
13	Access section	24 1/2	344.54				

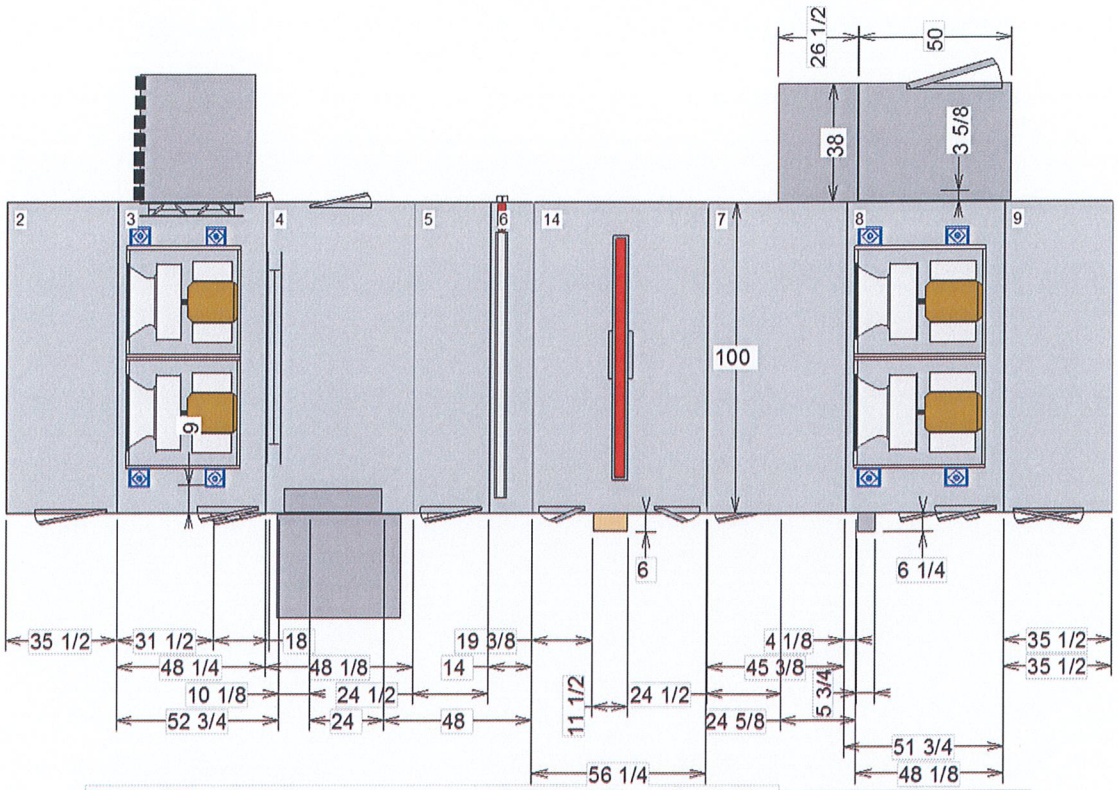


Basic Overall Plan View: Top - Measurements in inches

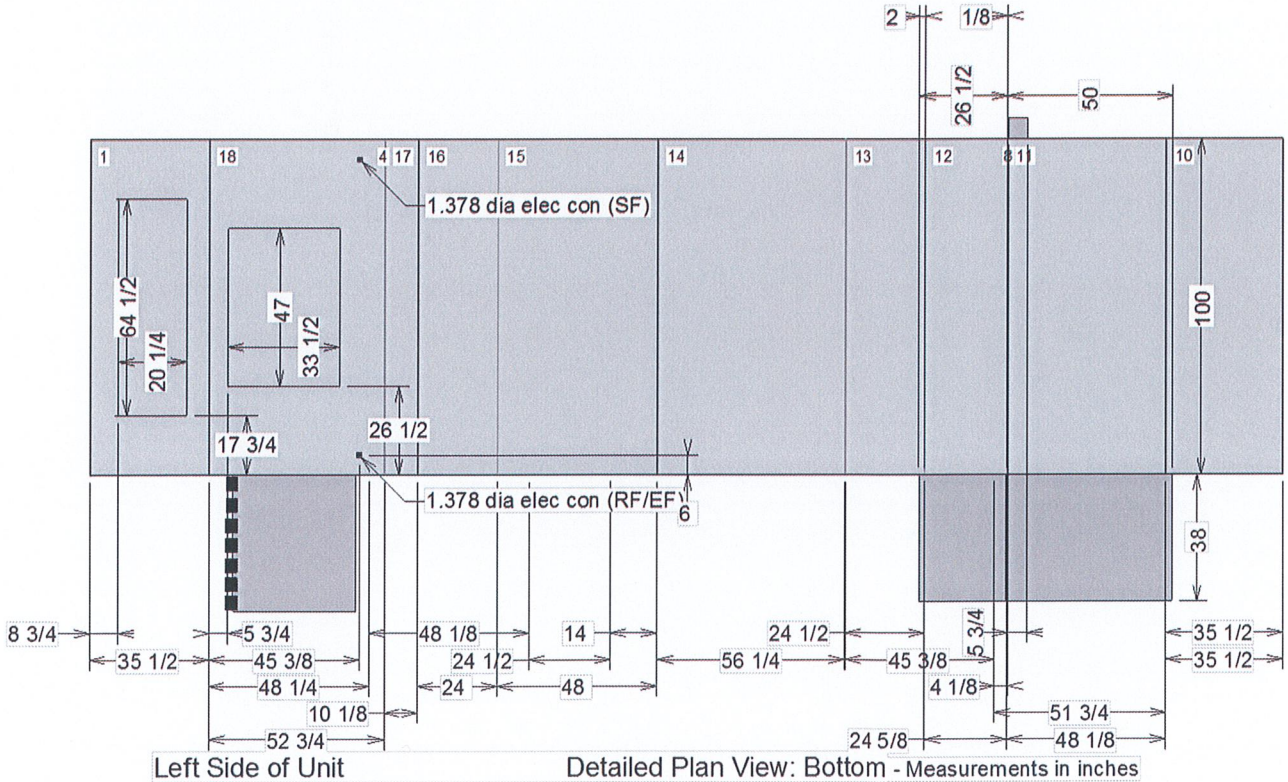
OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 15000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
Paint: Slate gray		Rigging weight: 15786.9 / Installed weight:

TRANE
Performance Climate Changer Air Handlers



Right Side of Unit — Detailed Plan View: Top - Measurements in inches



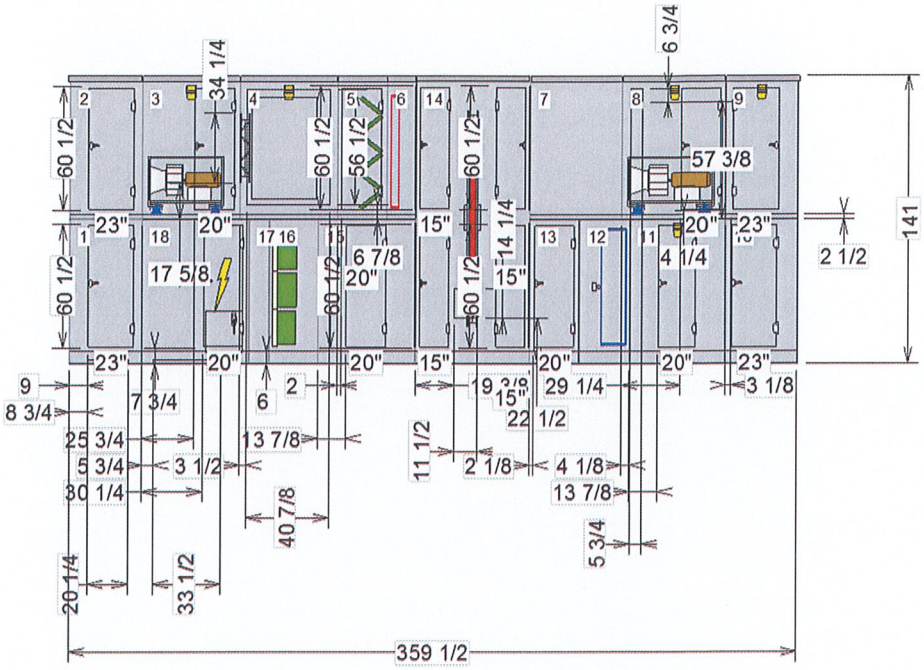
Left Side of Unit — Detailed Plan View: Bottom - Measurements in inches

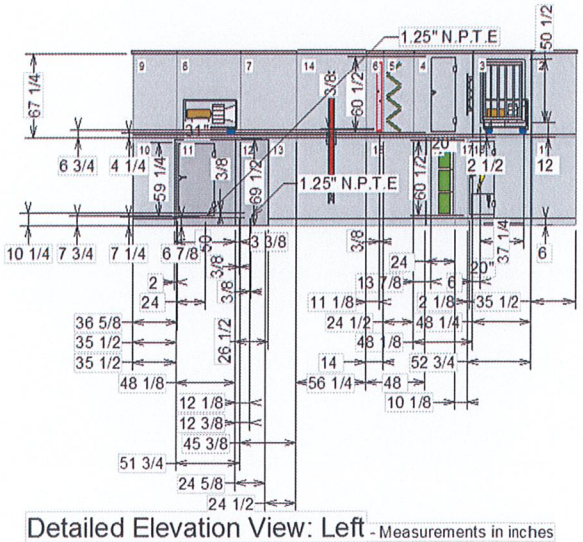
****Placement of electrical conduit may vary by a tolerance of 8" in any direction.**

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 15000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
Paint: Slate gray		Rigging weight: 15786.9 / Installed weight:

TRANE
Performance Climate Changer
Air Handlers



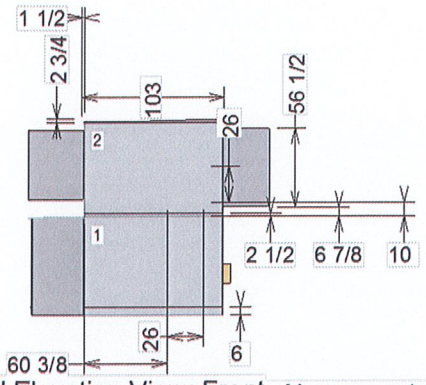


Detailed Elevation View: Left - Measurements in inches

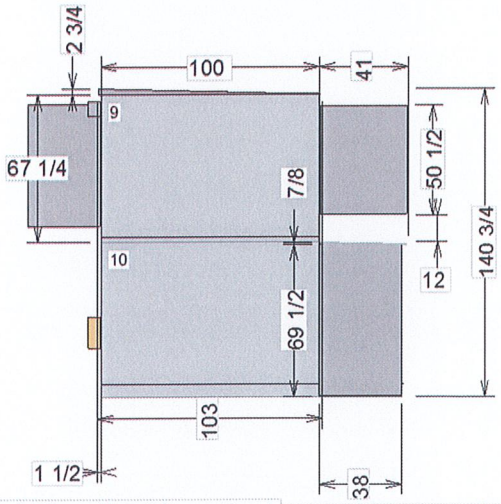
OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 15000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
Paint: Slate gray		Rigging weight: 15786.9 / Installed weight:

TRANE
Performance Climate Changer
Air Handlers



Detailed Elevation View: Front - Measurements in inches

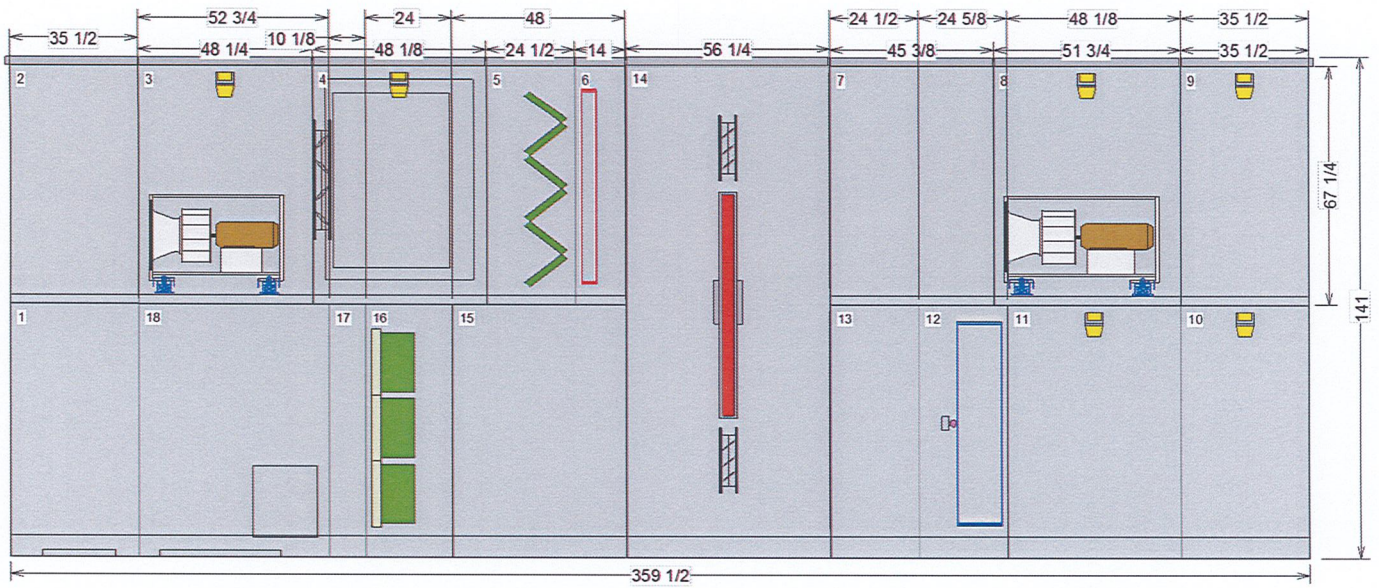


Detailed Elevation View: Back - Measurements in inches

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 15000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
Paint: Slate gray		Rigging weight: 15786.9 / Installed weight:

TRANE
Performance Climate Changer
Air Handlers

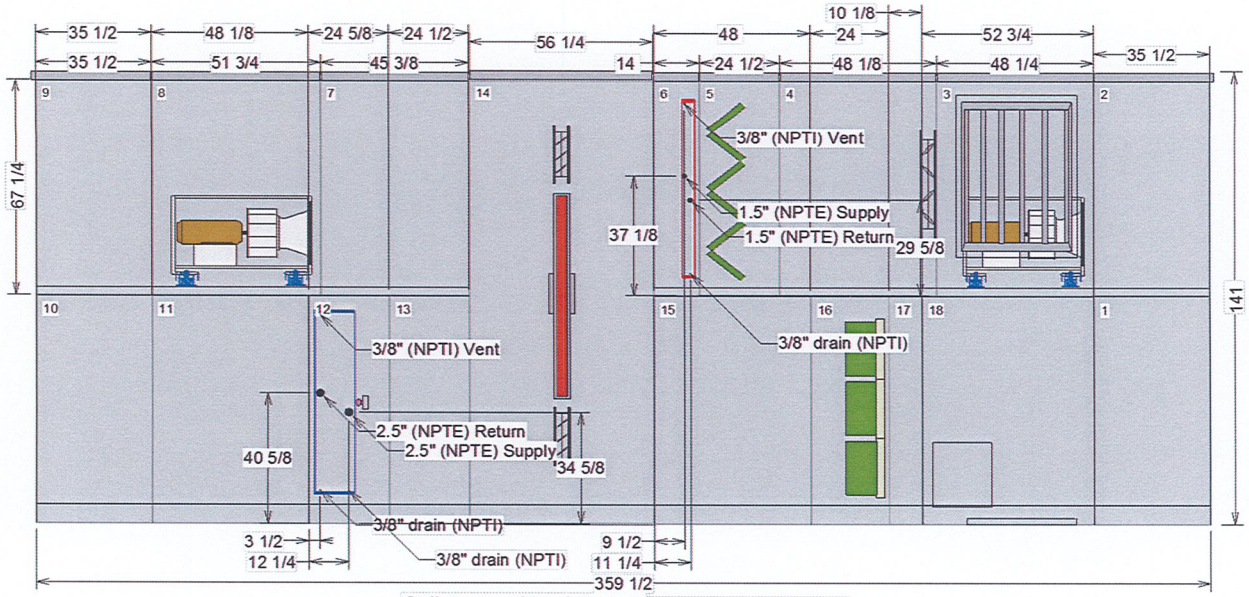


NPTI : National Pipe Thread Internal Connection
NPTE : National Pipe Thread External Connection

PENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCA

: size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
duct group: Outdoor unit	Actual airflow: 15000	Proposal Number:
gral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
nt: Slate gray		Rigging weight: 15786.9 / Installed weight: 16624.8

TRANE
Performance Climate Changer
Air Handlers



Coil connection view: Left - Measurements in inches

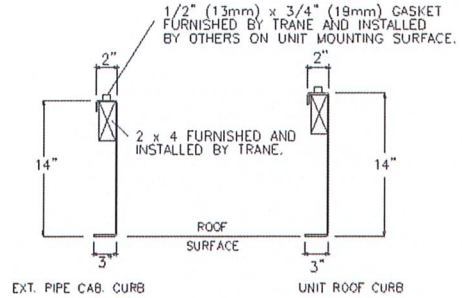
NPTI : National Pipe Thread Internal Connection
NPTE : National Pipe Thread External Connection

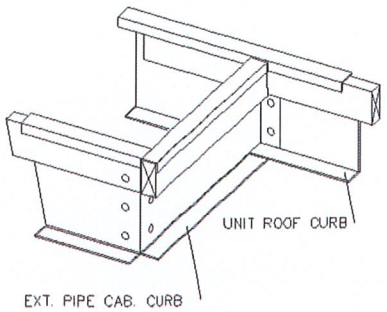
PENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCA

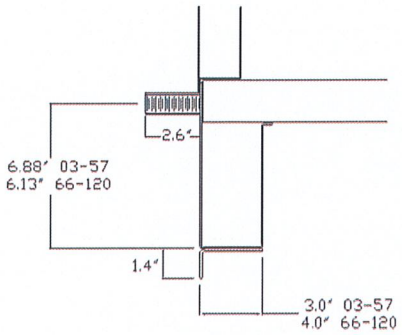
: size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
duct group: Outdoor unit	Actual airflow: 15000	Proposal Number:
gral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
nt: Slate gray		Rigging weight: 15786.9 / Installed weight: 16624.8

TRANE
Performance Climate Changer
Air Handlers

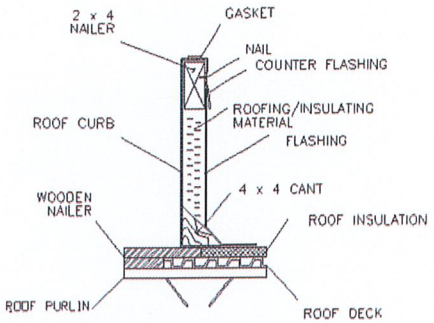
: size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
duct group: Outdoor unit	Actual airflow: 15000	Proposal Number:
gral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
nt: Slate gray		Rigging weight: 15786.9 / Installed weight: 16624.8



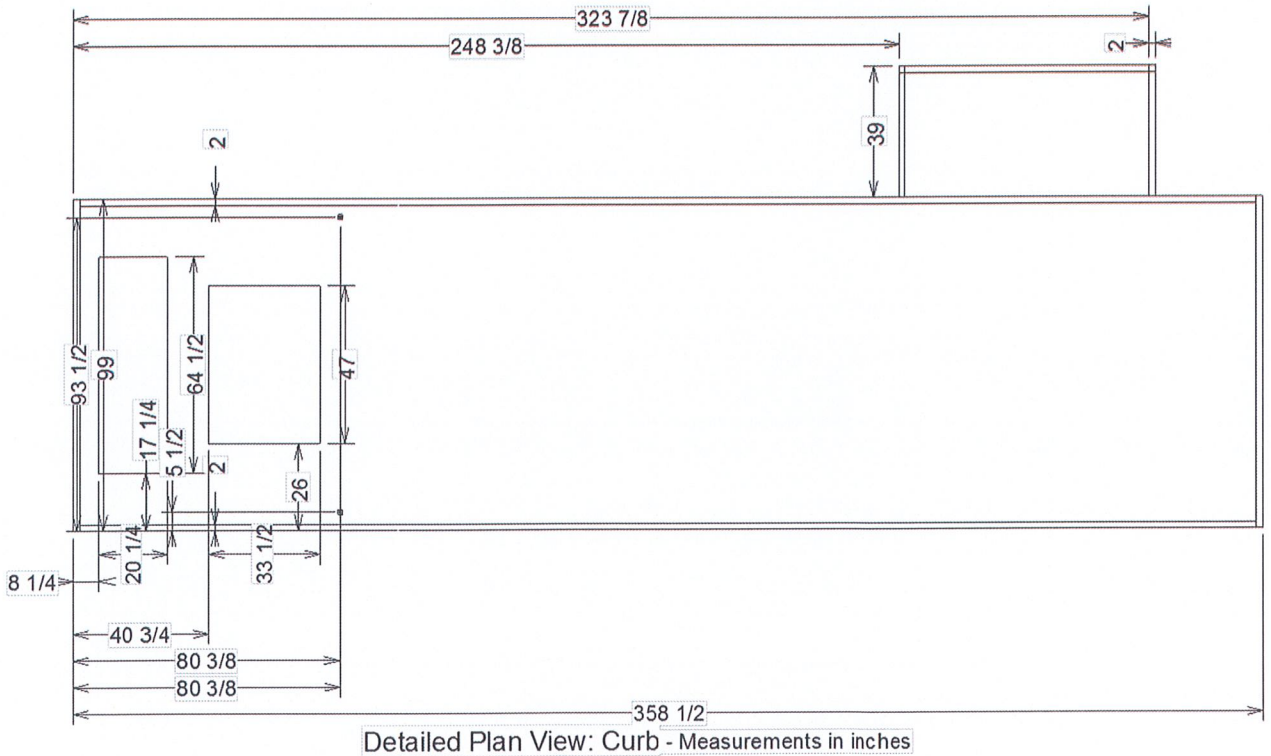




DRAIN CONNECTION



NOTE:
MATERIALS TO ATTACH ROOF CURB TO ROOF ARE TO BE SUPPLIED BY THE INSTALLER.



Detailed Plan View: Curb - Measurements in inches

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 35	Job Name: Lee's Summit ASC	Unit Casing: 2in Double Wall Foam
Product group: Outdoor unit	Actual airflow: 15000	Proposal Number:
Integral base frame: 6in. integral base frame	Sales Office:	Tags: AHU-02
Paint: Slate gray		Rigging weight: 15786.9 / Installed weight:

TRANE
Performance Climate Changer Air Handlers

Jeff L. Wright

From: Mike Galyardt <mike.g@branchpattern.com>
Sent: Monday, January 9, 2023 9:37 AM
To: Jeff L. Wright; Hannah Wilson; Rosemary Nelson
Subject: RE: HCA-LSMC Rooftop Mech Yard

Chiller in Mech Yard
Use 13,000#
(282)(88) = 75psf
144

Yes, install will match the last 2 clinics. See below for weight

Physical Information

Dimensions		Weights		Ch
Length	282 in	Operating	12781 lb	R
Width	88 in	Shipping	12639 lb	
Height	98 in			

Mike Galyardt
Associate
D 913 348 4607 C 316 207 7939
BranchPattern.com

From: Jeff L. Wright <jwright@bdc-engrs.com>
Sent: Monday, January 9, 2023 7:41 AM
To: Hannah Wilson <hannah.w@branchpattern.com>; Mike Galyardt <mike.g@branchpattern.com>; Rosemary Nelson <rnelson@aciboland.com>
Subject: RE: HCA-LSMC Rooftop Mech Yard

I assume the Chiller goes is ground supported and goes on a concrete pad in the mechanical yard. It lists the shipping weight as 12,639#. Is the operating weight higher? Please confirm operating weight.
Thanks,
Jeff

Jeff Wright, P.E., Principal
Office: 816.531.4144
Direct: 816.778.7146 **Cell:** 816.668.2261
4338 Belleview Ave. Kansas City, MO 64111
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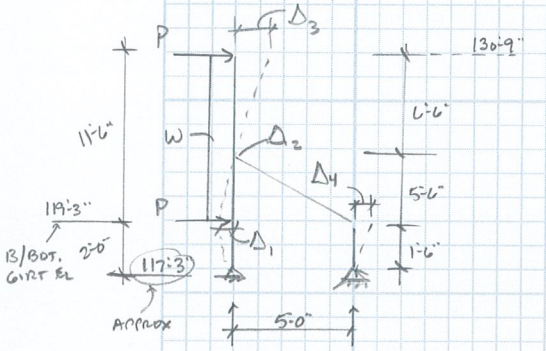
DESIGN SCREEN WALL FRAMING:



$P = (5.75)(5)(.030) = .8625^{k}$

$w = (5)(.030) = .15^{k}/_{FT}$

FOR HSS 6x6x3/8" POST & KICKERS

{RISA: SCREEN POST1.R2D}

$\Delta_1 = .004"$
$\Delta_2 = .049"$
$\Delta_3 = .432"$
$\Delta_4 = .042"$

$\Delta_3 - \Delta_2 = .432" - .049" = .383" \Rightarrow (6.5)(12)(2)/.383" = \ell/407$ OK

$\Delta_3 + \Delta_1 = .432" + .004" = .436" \Rightarrow (13.5)(12)/.436" = \ell/371$ OK

$\Delta_4 = .042" \Rightarrow (18)(2)/.042" = \ell/857$ OK

$R = 5.35^{k} \uparrow\downarrow$

$V = 3.82^{kips}/10'-0"_{OC} = .382^{k}/_{FT}$ ← LOAD TO ACCT. FOR IN LATERAL DESIGN

DETERMINE LOADS PER ASCE 7-16 SECTION 29.4.1

$K_z = .88$ ($h_{mean} = 18'-0"$)

$F_h = q_h (GC_r) A_f$ WHERE $q_h = .88(25.85) = 22.75$ PSF

$A_f = (11.5)(10) = 115$ FT.^{2}

$Bh_{max} = (33.5)(11.5) = 385.25$ FT.^{2} → .1Bh = 38.5 FT.^{2}

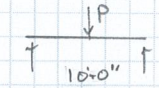
$Bh_{max} = (97)(11.5) = 1115.5$ FT. → .1Bh = 111.5 FT.^{2}

SINCE $A_f \approx$ .1Bh (111.5 ≈ 115 FT.^{2}) ∴ $GC_r = 1.9$

$P_f = (22.75)(1.9)(.6) = 25.93$ PSF ≈ USE $P_f = 30$ PSF

CHECK T&B GIRT

$\ell_{max} = 10'-0"$;



$P = (5.75)(5)(.030) = .862^{k}$ WIND

$P = (11.5)(.010)(5) = .575^{k}$ GRAVITY

$M_{lat.} = (.862)(10)/4 = 2.15^{k\text{-}FT}$ $S_x = (2.15)(12)/(6)(46) = .935$ IN.^{3}

$M_{A\,gravity} = (.575)(10)/4 = 1.43^{k\text{-}FT}$ $S_x = (1.43)(12)/(6)(46) = .1625$ IN.^{3}

FOR HSS 6x4x3/16" $S_x = 5.46$ IN.^{3} > .935 IN.^{3} OK

$S_y = 4.38$ IN.^{3} > .1625 IN.^{3} OK

$\Delta = (.862)(10x12)^3/48EI = 1.07/I = 1.07/164 = .06" \Rightarrow 120/.06" = \ell/1839$

COMPOUND Δ's = .432" + .06" = .49" $\Rightarrow (6.5)(12)(2)/.49" = \ell/317$ OK

$\Delta_{GRAVITY} = (.575)(10x12)^3/48EI = .713/I = .713/8.76 = .08" + (.012/12)(5)(120)^4/384EI = .093/8.76 = .011"$

$\Delta_{GRAVITY} = .091" \Rightarrow 120/.09 = \ell/1324$ OK

USE HSS 6x4x3/16" GIRTS T&B

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CHECK MIDDLE INTERMEDIATE MEMBER:

$\ell = 11'\text{-}6"$

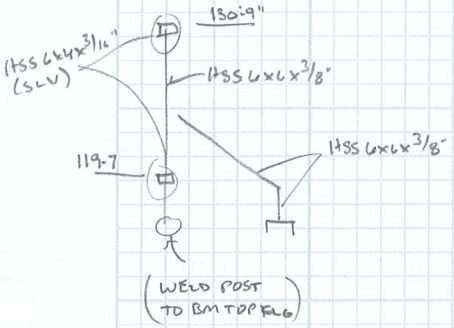
$w = (5)(.030) = .15^{k}/_{FT}$

$M = (.15)(11.5)^2/_8 = 2.47^{K\text{-}FT}$ $S_x = (2.47)(12)/_{21.6} = 1.37\,in^3 < 4.35\,in^3$ OK FOR C6x8.2

$\Delta = (.15/_{12})(5)(11.5\times12)^4/_{384E_I} = 2.03/_I = 2.03/_{13.1} = .155" \Rightarrow (11.5)(12)/_{.155} = \ell/_{888}$ OK

USE C6x8.2

SUMMARY



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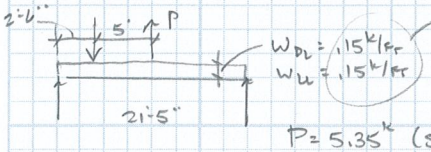
CHECK BMS W/ NORTH SIDE SCREEN LOADS:

{RISA: SCREEN BM 1.R2D}



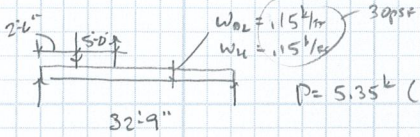
P = 5.35 K (SCREEN REACTION)

USING D + .75L + .75W: M_{max} = 26.7 K-FT $S_x = (26.7)(12)/30 = 10.68\ IN^3 < 33.4\ IN^3$ OK

$\Delta = .338" \Rightarrow \ell/759$ OK

USE W12X26

{RISA: SCREEN BM 2.R2D}



P = 5.35 K (SCREEN REACTION)

USING D + .75L + .75W M_{max} = 45.9 K-FT $S_x = (45.9)(12)/30 = 18.36\ IN^3 < 56.5\ IN^3$ OK

$\Delta = .684" = \ell/574$ OK

USE W16X36

CANOPY
MEMBER DESIGN

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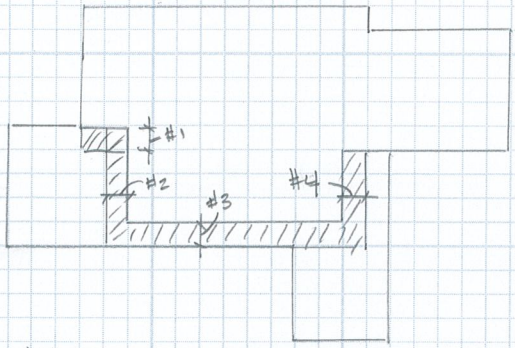
DRIFT LOADS ON CANOPIES:

LOW ROOF MAIN CANOPY: (FRONT CANOPY)



DRIFT #1:

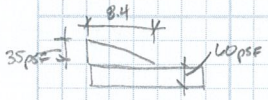
l_u = 90' (LEE) $h_d = .43\sqrt[3]{90}\sqrt[4]{20+10} - 1.5 = 3.0'$ ← CONTROLS

l_u = 42' (WIND) $h_d = .43\sqrt[3]{42}\sqrt[4]{20+10} - 1.5 = 1.99' \times .75 = 1.49'$

$\gamma = 16.6$ psf $P_d = (3)(16.6) = 49.96$ psf $P_p = 14$ psf

FOR 30 psf LL ADDITIONAL DRIFT = 30 − 14 psf = 16 psf

DRIFT = 49.96 − 16 psf = 33.96 ≈ USE 35 psf $w = (4)(3) = 12'\text{-}0" \left(\frac{35}{49.96}\right) = 8.4'$

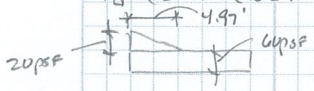


DRIFT #2

l_u = 50'-0" (LEE) → $h_d = .43\sqrt[3]{50}\sqrt[4]{20+10} - 1.5 = 2.21'$ ← (CONTROLS)

l_u = 50'-0" (WIND) → $h_d = .43\sqrt[3]{50}\sqrt[4]{20+10} - 1.5 = 2.21' \times .75 = 1.65'$

$P_d = (2.21')(16.6) = 36.64 - 16$ psf $= 20.64$ $w = (4)(2.21) = 8.84' \left(\frac{20.64}{36.64}\right) = 4.97'$

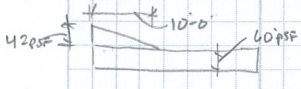


DRIFT #3

l_u = 120' (LEE) → $h_d = .43\sqrt[3]{120}\sqrt[4]{20+10} - 1.5 = 3.46'$

$P_d = (3.46)(16.6) = 57.49$ psf $- 16$ psf $= 41.49$ psf

$w = (4)(3.46) = 13.84' \left(\frac{41.49}{57.49}\right) = 9.99'$



DRIFT #4 (SAME AS DRIFT #2)

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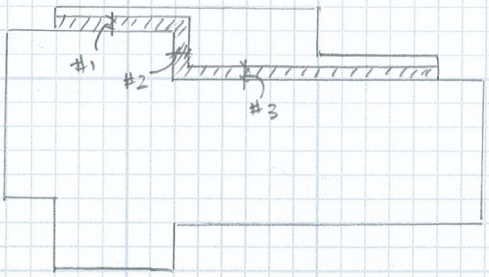
DRIFT LOAD ON BACK CANOPY:



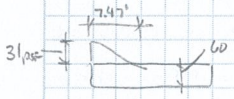
DRIFT #1: (SAME AS DRIFT LOAD #3 FROM FRONT CANOPY)

DRIFT #2:

$l_u = 80'$ (LEE) → $h_d = .43\sqrt[3]{80}\sqrt[4]{20+10} - 1.5 = 2.83'$ ← CONTROLS

$l_u = 66'$ (WIND) → $h_d = .43\sqrt[3]{66}\sqrt[4]{20+10} - 1.5 \times .75 = 1.92'$

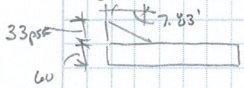
$P_d = (16.6)(2.83) = 47.08\,psf - 16 = 31.08\,psf$ $w = (4)(2.83)\left(\frac{31.08}{47.08}\right) = 7.47$



DRIFT #3

$l_u = 85$ (LEE) → $h_d = .43\sqrt[3]{85}\sqrt[4]{20+10} - 1.5 = 2.92'$

$P_d = (16.6)(2.92) = 48.55 - 16\,psf = 32.55\,psf$ $w = (4)(2.92)\left(\frac{32.55}{48.55}\right) = 7.83'$



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CHECK UPLIFT LOADS:

LOWROOF/MAIN CANOPY (FRONT CANOPY)

PER ASCE 7-16 -SEC 30.7

$P = q_h G C_N$ WHERE $q_h = 23.27$ PSF ($h = 20'-0"$)

$G = .85$

$.4h = (.4)(15) = 6'-0"$

$.1B$ OR $.1L = .1(32) = 3.2' \rightarrow a = 3.2'$

$4a^2 = (4)(3.2)^2 = 40$ FT.^{2}

FOR ROOF $\theta = 0°$

ALL TRIB AREAS > 40 FT.^{2} ∴ $C_N = +1.2$ OR -1.1

$P = (23.27)(.85)(+1.2) = 23.73$ PSF $\times .6 =$ 14.24 PSF

$(23.27)(.85)(-1.1) = 21.76$ PSF $\times .6 =$ 13.05 PSF

USE 15 PSF ← NOTE ASSUME DL = 0

SO NET UPLIFT = 15 PSF

PER ASCE 7-16 SEC 30.11

$p = q_h GC_p$ WHERE $q_h = 23.27$ (ASSUME WORST CASE)

$GC_p =$ -1.90

$h_e/h_e = 15/20 = .75$

$p = (23.27)(-.9) = 20.9$ PSF $\times .6 =$ 12.96 PSF

BACK CANOPY:

PER SECTION 30.11 OF ASCE 7-16

$p = q_h GC_p$ WHERE $q_h = 23.27$ PSF

$GC_p =$ -1.4 ASSUME WORST CASE

$h_e/h_e = (15'-6"/17'-6") = .88 \approx .9$

$p = (23.27)(-1.4) = 32.5 \times .6 =$ 19.5 PSF

ASSUME DL = 0 SO USE NET UPLIFT = 20 PSF

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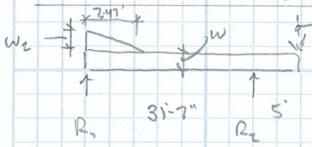
1.67k + .727 = 2.39 k DL
3.50k LL

BACK (NORTH CANOPY FRAMING):

IF ADD REACTION FROM EAST EYEBROW: $P = (2.5+1.33)(29.08/2)(.060+.033)+(5)(.010)(\frac{29.08}{2}) = 5.90^k$

BM @ GRIDLINE "B" (BTWN GRIDS D.8 & F):

{RISA: BACKCANOPY BM GRID B - D-B TO F.R2D}



$w_1 = (7+2.5)(.060) = .57^k/ft$

$= (.033)(7.83)(.5)(2.41/13.91) = .024^k/ft$ DRIFT

$.594^k/ft$ ($.29^k/ft$ DL, $.3^k/ft$ LL)

$w_2 = (7+2.5)(.031) = .29^k/ft$

FOR W16x40 $\Delta = .93" \Rightarrow (31.58)(12)/.93" = \ell/407$ OK

$\Delta_{CANT.} = .455" \leftarrow$ IF USE 50PSF $\rightarrow \Delta = .364" \leftarrow (5)(12)(2)/.364" = \ell/329$ OK

$R_1 = 10.82^k$

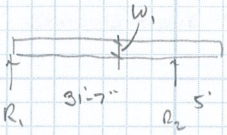
$R_2 = 13.44^k$ → 20.25k

USE W16x40

$\Delta_{CANT} = .307" \frac{1}{326}$ (USING COPSE TC)

FOR BM @ OUTSIDE EDGE OF CANOPY

{RISA: BACKCANOPY OUTSIDE EDGE - D-B TO F. R2D}



$w_1 = (2.5+1.33)(.060) = .23^k/ft$

$= (5)(.010) = .050$ (SOFFIT FRAMING)

$.28^k/ft$ ($.18^k/ft$ DL, $.12^k/ft$ LL)

FOR W16x26 $\Delta = .75" \rightarrow (31.58)(12)/.756" = \ell/501$ OK

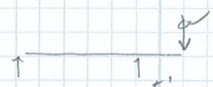
$\Delta_{CANT} = .37" \rightarrow (5)(12)(2)/.37" = \ell/324$

$R_1 = 4.76^k$ (

$R_2 = 6.49^k$

USE W16x26

FOR BM ON GRID "F"



$M = (6.49)(5) = 32.45^{k-ft}$ $S_x = (32.45)(12)/30 = 12.98\ in^3 < 64.7\ in^3$ OK

$\Delta = (6.49)(60)^2(228)/3E1 = 6122/I = 61.22/518 = .118" \Rightarrow (60)(12)/.118 = \ell/1015$ OK

I W16x40

USE W16x40

BM @ EAST EYEBROW (OUTSIDE EDGE)

$\ell = 29'-1"$

$w = (2.5+1.33)(.060+.033) = .356^k/ft$

$= (5)(.010) = .05^k/ft$

$.41^k/ft$ $\quad R = (.41)(29.08/2) = 5.96^k$

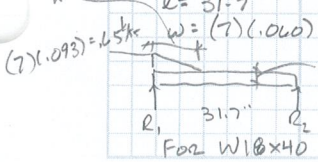
$M = (.41)(29.08)^2/8 = 43.33^{k-ft}$ $S_x = (43.33)(12)/30 = 17.33 < 38.4\ in^3$ OK FOR W16x26

$\Delta = (.41/12)(5)(29.08\times12)^4/384\times E\,II = 227/I = 227/301 = .755" \Rightarrow (29.08)(12)/.755 = \ell/461$ OK

USE W16x26

BM ALONG GRID "7" (D.8 TO F)

{RISA: BACKCANOPY GRID 7 - D-B TO F. R2D}



$\ell = 31'-7"$

$w = (7)(.060) + (.033)(7.83)(.5)(11.39/14) = .525^k/ft$

$M = 69.3^{k-ft}$ $S_x = (69.3)(12)/30 = 27.72\ in^3 < 68.4\ in^2$ OK

$\Delta = .72" \Rightarrow \ell/526$ OK

USE W18x40

$R_1 = 9.357^k$

$R_2 = 8.961^k$

USE W16x40 FOR BETTER UPLIFT CONTROL

FOR W16x40 $\Delta = .85" \Rightarrow \ell/445$ OK

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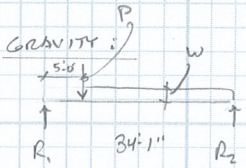
BM ALONG GRID "7" (F TO G) {RISA: BACKCANOPY BM GRID 7 - F TO G.R2D}

GRAVITY:



$w = (2.5)(.093) = .232^{k/ft}$
$(2.5)(.010) = .025^{k/ft}$ } $.257^{k/ft}$

$P = 5.96^{k}\,(9/14) = 3.83^{k}$

$R_1 = 3.83(29/34) + (.257)(29)(14.5/34) = 6.44^{k}$

$R_2 = 3.83(5/34) + (.257)(29)(19.5/34) = 4.83^{k}$

$M = 51.5^{k\text{-}ft}$ $S_x = (51.5)(12)/(.6)(46) = 22.39\ in.^3 < 78.6\ in.^2$

$\Delta = .5"$ ⇒ $(34.08)(12)/.5" = \ell/817$ OK USE HSS 20x8x5/16"

WIND LOAD (CONSERV SINCE DIAPHRAGM WILL STIFF LAT. DISTRIBUTION)

$\ell = 34'\text{-}1"$

$w = (17.5)(.5)(.020) = .175^{k/ft}$

$M = (.175)(34.08)^2/8 = 25.4^{k\text{-}ft}$ $S_x = 65.4(12)/(.6)(46) = 11.04\ in.^3 < 47.4\ in.^3$ OK FOR HSS 20x8x5/16"

$\Delta = (.175/12)(5)(34.08\times12)^4/384EI = 183/I = 183/189 = .969"$ ⇒

USE HSS 20x8x1/2 $I = 283$ $\Delta = .65"$ ⇒ $\ell/632$ OK

BM ALONG GRID "8" (C TO D) – USE SAME (D TO D.8)

GRAVITY:

$\ell = 28'\text{-}0"$

$w = (2.5)(.060+.042) = .255^{k/ft}$
$= (2.5)(.010) = .025^{k/ft}$ } $.28^{k/ft}$

$M = (.28)(28)^2/8 = 27.44^{k\text{-}ft}$ $S_x = (27.44)(12)/(.6)(46) = 11.93\ in.^3 < 57\ in.^3$ OK FOR HSS 18x6x5/16"
< 56.4 OK FOR HSS 16x8x5/16"

$\Delta = (.28/12)(5)(28\times12)^4/384EI = 133/513 = .26"$ ⇒ $(28)(12)/.26 = \ell/1290$ OK FOR HSS 18x6
$133/451 = .29"$ ⇒ $\ell/1139$ → OK FOR HSS 12x8

WIND LOAD (CONSERV SINCE DIAGRAGM WILL STIFFEN LATERALLY)

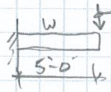
$\ell = 28'\text{-}0"$

$w = (17.5/2)(.020) = .175^{k/ft}$

$M = (.175)(28)^2/8 = 17.15^{k\text{-}ft}$ $S_x = (17.15)(12)/(.6)(46) = 7.45\ in.^3 < 30.4\ in.^3$ OK FOR HSS 18x6x5/16"

$\Delta = (.175/12)(5)(28\times12)^4/384EI = 83/I = 83/155 = .54"$ ⇒ $(28)(12)/.54" = \ell/622$ OK USE HSS 16x8x5/16"

DESIGN CANTILEVER:



SOFFIT

(G) $P = 5.96^{k}$ (@ GRID G); $w = (2.5)(.093) + .05 = .28^{k/ft}$

(D.8) $P = (.28^{k/ft})(31.58/2) + [(2.5+1.33)(.060+.042)+.050](15.75/2) = 7.89^{k}$; $w = (5)(.060+.042) = .51^{k/ft}$

WORST CASE → (D) $P = [(2.5+1.33)(.060+.042)+.050][(27.9)+15.75)/2] = 9.62^{k}$; $w = (5)(.060+.042) = .51^{k/ft}$

(C) $P = [(2.5+1.33)(.060+.042)+.050][27.91/2] = 6.14^{k}$; $w = (2.5)(.060+.042)+.05 = .31^{k/ft}$

$M = (9.62)(5) + (.51)(9)^2/2 = 68.75^{k\text{-}ft}$ $S_x = (68.75)(12)/(.6)(46) = 29.89\ in.^3 < 56.4$ OK FOR HSS 16x8x5/16"

$\Delta = (9.62)(60)^3/3EI + (.51/12)(60)^4/8EI = 26.25/I = 26.25/451 = .058"$ ⇒ $(60)(12)/.058" = \ell/2061$ OK

USE HSS 16x8x5/16"

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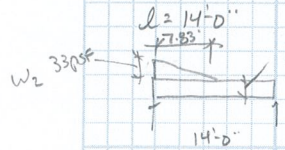
NORTH-SOUTH SPANNING BMS BTWN D.8 & F



$w_1 = (5.33)(.060) = .32^{k/ft}$

$w_2 = (5.33)(.033) = .175^{k/ft}$

$M = 9^{k\text{-}ft} \Rightarrow S_e = (9)(12)/30 = 3.6\ in^3 < 14.9\ in^3$ OK FOR W12X14

$\Delta = .125" \Rightarrow (14)(12)/.125" = \ell/1344$ OK USE W12X14

{RISA: TYPBACKCANOPYBM.R2D}

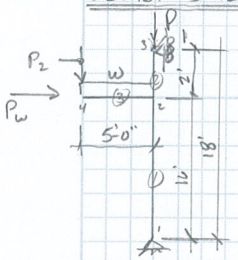
CHECK UPLIFT (NET UPLIFT = 20psf)

$w = (5.33)(.020) = .11^{k/ft}$

$M = (.11)(14)^2/8 = 2.6\ k\text{-}ft$ $f_b = (2.6)(12)/14.9 = 2.10\ ksi < F_b = 1000/((14)(13.3)) = 5.37\ ksi$ OK

USE W12X14

DESIGN EXTERIOR COLS @ C-8, D-8, D.8-8, AND G-7



$P_1 = 35.1^k + 4.83^k = 39.93^k$

$= 5.96^k + 10.82^k + 2.20^k = 18.98^k$

$= 20 + 14^k + 6.125^k = 26.26^k$

$= 30.78^k + 3.92^k = 34.7^k$

$P_2 = 5.96^k$ (G) $= 7.89^k$ (D.8) $= 9.62^k$ (D) $= 6.14^k$ (C)

$P_w = (34)(.5)(.175^{k/ft}) = 2.97^k$

$= (15.75 + 31.58)(.5)(.175^{k/ft}) = 4.14^k$

$= (28 + 15.75)(.5)(.175^{k/ft}) = 3.82^k$

$= (28)(.5)(.175^{k/ft}) = 2.45^k$

USING WORST LOADS → {RISA: BACKCANOPYWINDCOL.R2D}

$P_1 = 39.93^k$; $P_2 = 9.62^k$ $P_w = 4.14^k$ $w = (5.33)(.060) = .32^{k/ft}$

(CONSIDER IN UNITY CHECK)

$P_{up_{max}} = (2.5+1.33)(28/2)(.020) = 1.07^k$ (C)

$= (2.5+1.33)(28+15.75)(.5)(.020) = 1.67^k$ (D)

$= (2.5+1.33)(15.75+31.58)(.5)(.020) = 1.81^k$ (D.8) ← (CONTROLS)

$= (2.5+1.33)(29.08)(.5)(.020) = 1.11^k$ (G)

$w_{up} = (5.33)(.020) = .11^{k/ft}$

FOR RISA:

Add Cantilever Load for Conserv. Worst Case

$M_{MAX\ COL} = 53.67^{k\text{-}ft}$ $\Delta_{max} = .32" \Rightarrow (18)(12)/.32" = \ell/675$ USE HSS 12x8x5/16" COL

$P_{MAX} = 39.93^k + 9.62^k = 49.55^k$ $\Delta_{END} = .41" \Rightarrow (60)(12)/.41 = \ell/292$ OK

* UNITY CHECK ($K\ell = 18'-0"$) $\Rightarrow .83 < 1.0$ OK {EXCEL: ASTEEL.XLS}

USE HSS 12x8x5/16" DESIGN FOR 55 kip-ft MOMENT CONN OF HSS 16x8x5/16" OUTRIGGER

BASE R (SEE SPREADSHEET) → $t_{req} = .64"$ = USE 1" x 14" x 14" BASE R

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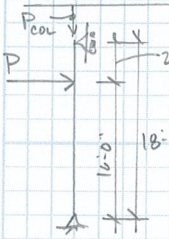
CHECK COL @ F-7:



$P = .175^{k/ft}(31.58 + 34.08)(.5) = 5.745^{kips}$

$M = (5.745)(2)(16)/18 = 10.21^{k\text{-}ft}$

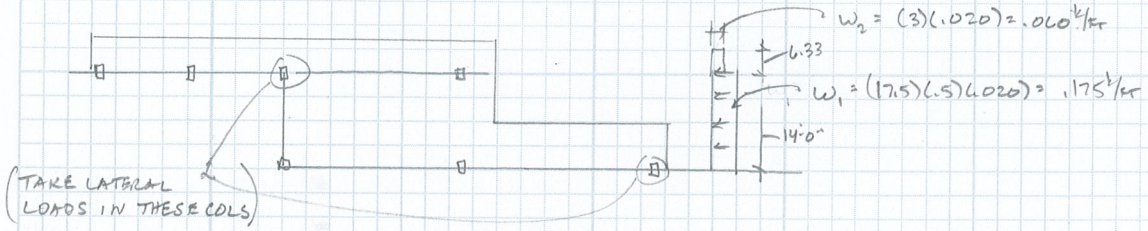
$\Delta = (5.745)(24)(192)(408)\left[(3)(24)(408)\right]^{1/2} / 27EI(18)(12) = 10.94/I = 10.94/79.1 = .138" \rightarrow \frac{(18)(12)}{.138} = \frac{\ell}{1560}$ OK

$P_{co\,max} = 38.1^{k}$ } FOR HSS 8x6x3/8"
UNITY = .50 ≤ 1.0 OK
{EXCEL: ASTEEL2.XLS}

$M_{col} = 10.21^{k}$ }

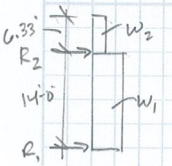
USE HSS 8x6x3/8" COL — BASE PL (SEE SPREADSHEET) $t_{REQ} = .57" \Rightarrow$ USE 1"x14"x12" BASE PL

* CHECK COLS FOR WEAK AXIS BENDING TO TAKE EAST-WEST WIND LOAD



$w_2 = (3)(.020) = .060^{k/ft}$

$w_1 = (17.5)(.5)(.020) = .175^{k/ft}$

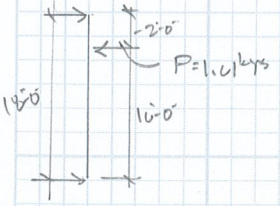


$R_1 = (.175^{k/ft})(14/2) = 1.225^{kips}$

$R_2 = (.175^{k/ft})(14/2) + (6.33)(.060^{k/ft}) = 1.61^{kips}$

(CONSERVATIVELY ADDED $M_x + M_y$)

CHECK HSS 12x8x5/16" FOR WEAK AXIS BENDING



$M = (1.61)(2)(16)/18 = 2.86^{k\text{-}ft}$

$P_{max\,col} = 49.55^{k}$ (FROM PREVIOUS CALC FOR WORST CASE)

UNITY CHECK = .87 ≤ 1.0 OK {SEE EXCEL ASTEEL.XLS}

$\Delta = (1.61/5.745)(10.94/I) = 3.06/I$ WHERE $I = I_y = 120$ $3.06/120 = .02" \Rightarrow \frac{(18)(12)}{.0255} = \frac{\ell}{8470}$ OK

COL LOAD @ D.8-7

$P = 9.357^{k}$ (REACTION FROM BM ON GRID 7)

$= (2.5)(7)(.06+.031) + (5)(.010)(7) = 1.94^{k}$ REACTION FROM BM ON GRID D.8

$= 11.47^{k}$ (REACTION FROM MAIN ROOF BM ON GRID 7)

$= (2.5)(25.25)(.5)(.060) = 1.89^{k}$ (REACTION FROM MAIN ROOF BM ON GRID D.8)

} 24.66^{kips}

FOR KL = 18'-0" USE HSS 5x5x1/4" $P_{nc} = 54^{k} > 24.66^{k/ps}$ OK

FOR FTG $P = 24.66 + (4)(18)(.040) = 27.54^{k} / 2.5^{ksf} = 3.31' =$ USE 4'-0" ϕ FTG

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NOTE: BRACING GOVERNS (SEE BRACE CALCS)

BACK CANOPY COL FTGS:

@ C-8: $P = 34.7^k + 6.14^k = 40.84^k + [(4)(18)(.040) = 2.88^k]_{BRACE} = 43.72^k \rightarrow FTG = \sqrt{43.72/2.5ksf} = 4.18' \rightarrow$ USE 4'-6" ϕ

@ D-8 $P = 26.26^k + 9.62^k = 35.88^k + [(4)(18)(.040) = 2.88^k] = 38.76^k \rightarrow FTG = \sqrt{38.76/2.5ksf} = 3.93' \rightarrow$ USE 4'-6" ϕ

@ D.8-8 $P = 18.98^k + 7.89^k = 26.87^k + [(4)(18)(.040) = 2.88^k] = 29.75 \rightarrow FTG = \sqrt{29.75/2.5ksf} = 3.44' \rightarrow$ USE 4'-0" ϕ

@ G-7 $P = 39.93^k + 5.96^k = 45.89^k + [(4)(18)(.040) = 2.88^k] = 48.77^k \rightarrow FTG = \sqrt{48.77/2.5ksf} = 4.41' \rightarrow$ USE 5'-0" ϕ

(WIDE FTG OUT TO ACCEPT WING WALL)

CHECK COL @ F-8"

$P = 20.25^k + (6.49)(19/14) = 29.05^k \rightarrow$ USE HSS 5x5x1/4" $P_{allow} = 66^k > 29.05^k$ (LL=16'-0")

$\rightarrow FTG = 29.05^k + (3)(16)(4)(.040) = 36.73^k \rightarrow FTG = \sqrt{36.73/2.5ksf} = 3.83'$

USE 4'-6" ϕ

MAX UPLIFT = (PQ = 20psf)

$P = [(31.58)(14)(.25) + (6.33)(31.58)(.5) + (6.33)(14/2 + 6.33)](.020) = 5.89^k$

WT OF FTG = $(4.5)^2(2.67)(.150) = 8.11^k \times .6 = 4.86^k < 5.89^k$ ∴ USE 5'-0" ϕ FTG

$WT = (5)^2(2.67)(.150) = 10.0^k \times .6 = 6^{keys} > 5.89^k$ OK

USE 5'-0" ϕ FTG

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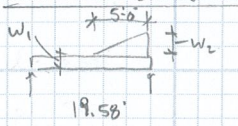
DESIGN LOW ROOF / MAIN CANOPY:

BMS BTWN GRIDS A & B: {RISA: LOWRFBMA.RZD}



$W_1 = (5.5)(.060) = .33^{k}/_{ft}$

$W_2 = (5.5)(.020) = .11^{k}/_{ft}$

$R_1 = 3.53^{k} / 5.5' = .64^{k}/_{ft}$ ($.29^{k}/_{ft}$ DL, $.34^{k}/_{ft}$ LL)

$R_2 = 4.4^{k} / 5.5' = .8^{k}/_{ft}$ ($.29^{k}/_{ft}$, $.51^{k}/_{ft}$ LL)

$M = 17.9^{k\text{-}ft}$ $S_x = (17.9)(12)/30 = 7.16\ in.^3 < 21.3\ in.^3$ OK FOR W12X19

$\Delta = .33" \Rightarrow l/711$ OK

USE W12X19

CHECK FOR 15psf UPLIFT

$w = (5.5)(.015) = .0825^{k}/_{ft}$

$M = (.0825)(19.58)^2/8 = 3.95^{k\text{-}ft}$ $f_b = (3.95)(12)/21.3 = 2.22\ ksi < F_b = 1000/(19.58)(8.67) = 5.89\ ksi$ OK

BMS BTWN GRIDS xA & A.2 (BMS SAME FOR BMS BTWN GRID x1 & x2)

$l = 29.36'$

$w = (5.5)(.060) = .33^{k}/_{ft}$

$M = (.33)(29.36)^2/8 = 35.56^{k\text{-}ft}$ $S_x = (35.56)(12)/30 = 14.22\ in.^3 < 33.4\ in.^3$ OK FOR W12X26

$\Delta = (.33/12)(5)(29.36 \times 12)^4/384EI = 190/I = 190/204 = .93" = (29.36)(12)/.93 = l/378$ OK ← (NOTE 60PSF TL IS CONSERV.)

USE W12X26 ← NOTE: BY INSPECTION, BM ALONG GRID "2" OK TO BE W12X26

CHECK FOR 15 psf NET UPLIFT $w = .0825^{k}/_{ft}$

$M = (.0825)(29.36)^2/8 = 8.88 \Rightarrow f_b = (8.88)(12)/33.4 = 3.19\ ksi < F_b = 1000/(29.36)(4.95) = 6.88\ ksi$ OK

BMS ALONG GRID "3" (1 TO 3.5)

$l_{max} = 20.5'$

$W_{DL} = .29^{k}/_{ft}$ DL + (5)(.010) (W&CWT.) $= .34^{k}/_{ft}$

$W_{LL} = .51^{k}/_{ft}$

} $.85^{k}/_{ft}$

$M = (.85)(20.5)^2/8 = 44.65^{k\text{-}ft}$ $S_x = (44.65)(12)/30 = 17.86 < 33.4\ in.^3$ OK FOR W12X26

$\Delta = (.85/12)(5)(20.5 \times 12)^4/384EI = 116/I = 116/204 = .56" \Rightarrow (20.5)(12)/.56 = l/432$ OK

USE W12X26

BM @ GRID A.2 (2 TO 3.5)

$l = 16.33'$

$W_{DL} = (23)(.030) + (3)(.010) = .72^{k}/_{ft}$

$W_{LL} = (23)(.030) + (.020)(5)(.5)(1.667/16.67) = .70^{k}/_{ft}$

} $1.42^{k}/_{ft}$

$M = (1.42)(16.33)^2/8 = 47.16^{k\text{-}ft}$ $S_x = (47.16)(12)/30 = 18.86\ in.^3 < 33.4\ in.^3$ OK

$\Delta = (1.42/12)(5)(16.33 \times 12)^4/384EI = 78.3/I = 78.3/204 = .384" \Rightarrow l/510$ OK ← (60 psf CANOPY LOAD CONSERV.)

USE W12X26

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BM ALONG GRID 3.5 (A.2 TO B)

$\ell = 16.67'$

$w = (.060 + .035\ \text{DRIFT})(2.75) + \underset{\text{WALL}}{(5)(.010)} = .131^{k}/_{ft}$

$M = (.131)(16.67)^2/8 = 10.8\ k\text{-ft}$ $S_R = 4.32\ in^3 < 23.3\ in^3$ OK FOR W12X19

$\Delta = (.131/12)(5)(16.33\times12)^4/384EI = 17.10/130 = .131'' \Rightarrow \ell/1489$ OK **USE W12X19**

BM ALONG GRID "A" (1 TO 2)

$\ell = 20.5'$

$w_{DL} = (23)(.030) + \underset{\text{WALL}}{(3)(.010)} = .72^{k}/_{ft}$

$w_L = (23)(.030) + (.020)(5)(.5)(1.667/19.58) = .70^{k}/_{ft}$ } $1.42^{k}/_{ft}$

$M = (1.42)(20.5)^2/8 = 74.59$ $S_R = (74.59)(12)/30 = 29.83\ in^3 < 45.86\ in^3$ OK FOR W12X35

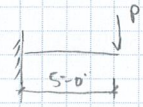
$\Delta = (1.42/12)(5)(20.5\times12)^4/384EI = 194/I = 194/285 = .68'' \Rightarrow (20.5)(12)/.68 = \ell/360$

IF CONSIDER TL = 50psf $\Delta = (.8)(.68) = .544'' \Rightarrow \ell/450$

$\Delta_L = .27'' \Rightarrow \ell/911$ } **USE W12X35**

COMBINED INTO ONE BM

CANT BM @ GRID "A" (SOUTH OF GRID 1)



$P = (2.5+1.33)(23)(.060) = 5.28^{k}$
$= (23)(5)(.010) = 1.15^{k}$ } 6.43^{k}

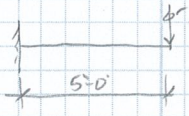
$M = (6.43)(5) = 32.17^{k\text{-ft}}$

$f_b = (32.17)(12)/45.6 = 8.46\ ksi < F_b = 1000/(2.66)(10) = 27\ ksi$ OK

$\Delta = (6.43)(5\times12)^3/3EI = 15.96/I = 15.96/285 = .056'' \Rightarrow (5)(12)(2)/.056 = \ell/2142$ OK

USE W12X35 OK →

CANT BM @ GRIDS "B" & C"



$P = (2.5+1.33)(20)(.060 + .042\ \text{(DRIFT)}) = 7.82^{k}$
$= (5)(20)(.010) = 1\ kip$ } 8.82^{k}

$M = (8.82)(5) = 44.1^{k\text{-ft}}$

$S_R = (44.1)(12)/(.6)(46) = 19.17\ in^3 < 37.4\ in^3$ OK FOR HSS 12x8x5/16"

$\Delta = (8.82)(60)^3/3EI = 21.9/I = 21.9/224 = .098'' \Rightarrow (60)(2)/.098 = \ell/1227$ OK

USE HSS 12x8x5/16"

EDGE BMS ALONG SOUTH SIDE OF CANOPY

$\ell_{max} = 20.5'$

$w = (2.5+1.33)(.06+.042) = .39^{k}/_{ft}$
$= (5)(.010) = .050^{k}/_{ft}$ } $.44^{k}/_{ft}$

$M = (.44)(20.5)^2/8 = 23.14^{k\text{-ft}}$ $S_R = (23.14)(12)/30 = 9.25 < 21.3\ in^3$ OK

$\Delta = (.44/12)(5)(20.5\times12)^4/384EI = 60.29/130 = .46'' \Rightarrow (20.5)(12)/.46 = \ell/534$ OK **USE W12X19**

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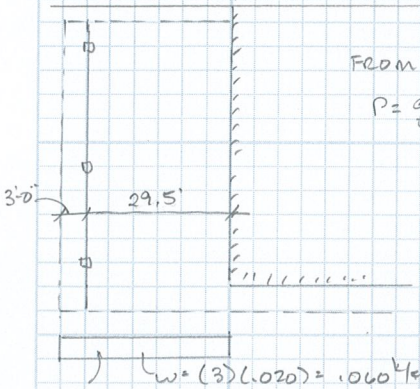
DESIGN FRAME FOR CANOPY @ GRID "XA"



FROM ASCE 7-16 SECTION 27.3.2

$P = q_h G C_N$ WHERE q_h = 23.27 PSF (CONSERV SINCE BASED ON h_{AVE} = 20'-0" & CANOPY ONLY @ 15'-0").

$G = .85$

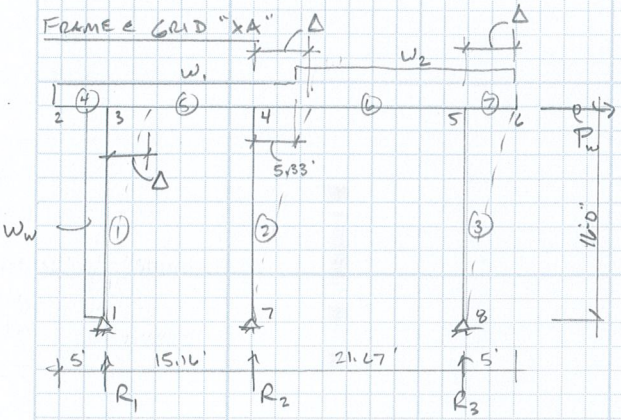
$C_N = \pm 1.2$ (WORST CASE)

$P = (23.27)(.85)(1.2) = 23.73 \times .6 = 14.24$ PSF ≈ USE 15 PSF

** NOTE: USE ONLY DL = 10PSF TO RESIST UPLIFT CASES

USE 20PSF DL
30PSF LL (FOR CANOPY DESIGN)

FRAME @ GRID "XA"



$w_{1DL} = (16.25)(.020) = .325$ k/ft

$w_{1LL} = (16.25)(.030) = .488$ k/ft

$w_{1WIND} = (16.25)(.015) = .244$ k/ft ↓↑

$w_{2DL} = (17.75)(.020) = .355$ k/ft

$w_{2LL} = (17.75)(.030) = .533$ k/ft

$w_{2WIND} = (17.75)(.015) = .266$ k/ft ↓↑

$w_W = (3)(.020) = .060$ k/ft

$P_W = (29.5/2 + 3)(.060)$ k/ft = 1.07 kips

LOAD COMBS

D+L

D+.75L+.75W

D+W

.6D+W ← UPLIFT FOR WIND

{RISA: CANOPY FRAME XA.R2D}

FOR HSS 10X6X5/16" COLS
W12X26 BMS

$\Delta_{LATERAL} = .566" \Rightarrow (16)(12)(2)/.566 = \ell/678$ OK

$\Delta_4 = .069" \Rightarrow \ell/1739$ OK

$\Delta_5 = .024" \Rightarrow \ell/7580$ OK

$\Delta_6 = .329" \Rightarrow \ell/790$ OK

$\Delta_7 = .171" \Rightarrow \ell/701$ OK

$R_1 = 11.32^k \downarrow \quad (-2.24^k \uparrow)$

$R_2 = 19.52^k \downarrow \quad (-3.00^k \uparrow)$

$R_3 = 15.66^k \downarrow \quad (-2.72^k \uparrow)$

USE HSS 10X6X5/16" COLS
W12X26 BMS

USE 16X12X1 1/4" BASE R W/ (4) 3/4"Φ ABs W/ 2'-6" Lg. EMBED & WASH. R

For $f_{brg\,soil}$ = 2500 PSF R_1: $P = 11.32^k + (7)(2.67)(4)(.040) = 14.31^k$

FTG = $\sqrt{14.31/2.5} = 2.39' \approx$ USE 3'-6" FTG WT = $(3.5)^2(2.67)(.150) = 4.90^k \times .6 = 2.94^k > 2.24^k \uparrow$ OK FOR UPLIFT

R_2: $P = 19.52^k + (7)(2.67)(4)(.040) = 20.52^k$

FTG = $\sqrt{20.52/2.5} = 3.0 \approx$ USE 4'-0" FTG WT. $(4)^2(2.67)(.150) = 6.4^k \times .6 = 3.84^k > 3.00^k \uparrow$ OK FOR UPLIFT

R_3: $P = 15.66^k + (7)(2.67)(4)(.040) = 18.66^k$

FTG = $\sqrt{18.66/2.5} = 2.73' \approx$ USE 3'-6" FTG WT. = $(3.5)^2(2.67)(.150) = 4.90^k \times .6 = 2.94^k > 2.72^k \uparrow$ OK FOR UPLIFT

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SIZE BMS ALONG GRID 1 (BTWN GRIDS B & D.1)

$\ell = 20'-6"$

$w_{GRAVITY} = (2.5)(.060+.042) + (5)(.015) = .33^{k}/_{FT}$

$w_{WIND} = (\frac{20}{2})(.020) = .2^{k}/_{FT}$

$M = (.33)(20.5)^2/8 = 17.33^{k\text{-}FT} \Rightarrow S_x = (17.33)(12)/(.6)(46) = 7.53\ in^3 < 37.4$ OK

$\Delta_{GRAV.} = (.33/12)(5)(20.5\times12)^4/384E_1 = 45.2/I = 45.2/224 = .20" \Rightarrow \ell/1218$ OK

$\Delta_{WIND} = (.2/.33)(45.2/I) = 27.39/I = 27.39/120 = .23" \Rightarrow \ell/1077$ OK

USE HSS 12x8x5/16" (LLV)

$\ell = 29'-2"$

$M = (.33)(29.17)^2/8 = 35.1^{k\text{-}FT}$ $S_x = (35.1)(12)/(.6)(46) = 15.26\ in^2 < 78.6\ in^3$ OK

$\Delta = (.33/12)(5)(29.17\times12)^4/384E_1 = 185/I = 185/786 = .235" \Rightarrow (29.17)(12)/.235" = \ell/1484$ OK

$\Delta_{WIND} = (.2/.33)(185/I) = 112/I = 112/189 = .59" \Rightarrow (29.17)(12)/.59" = \ell/590$ OK

ADD PT LOAD @ MID SPAN.

$P = (8.75)(.5)(16.5+21.5)(.5)(.060+.042) = 8.5^{k}$

$\Delta = (8.5)(29.17\times12)^3/48E_1 = 261/I + 185/I = 446/I = 446/786 = .567" \Rightarrow (29.17)(12)/.567" = \ell/616$ OK

USE HSS 20x8x5/16" (LLV)

FOR BM ALONG GRID D.1:

$\ell = 25'-2"$

$w = (4.5)(.060+.020) + (5)(.015) = .435^{k}/_{FT}$ (GRAVITY)

$w = (20/2)(.020) = .2^{k}/_{FT}$ (WIND)

$M = (.435)(25.16)^2/8 = 34.42^{k\text{-}FT} \Rightarrow S_x = (34.42)(12)/(.6)(46) = 14.95\ in^3 < 56.4\ in^3$ OK

$\Delta = (.435/12)(5)(25.16\times12)^4/384E_1 = 135/I = 135/451 = .3" \Rightarrow (25.16)(12)/.3 = \ell/1006$ OK

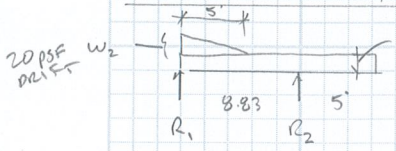
$\Delta_{WIND} = (.2/.435)(135/I) = 62/I = 62/155 = .40" \Rightarrow (25.16)(12)/.40" = \ell/753$ OK

NOTE: DIAPHRAGM OF CANOPY STIFFNESS OK TO SPAN LATERALLY BTWN COLS @ D.1-1 AND D.1-2.3. THEREFORE USE W16X26 $\Delta = 135/301 = .448" \Rightarrow \ell/673$ OK

USE W16X26

USE HSS 16x8x5/16" (LLV)

CHECK OUTRIGGERS EAST OF GRID "D.1":



$w_1 = (3.67)(.060) = .22^{k}/_{FT}$

$w_2 = (3.67)(.020) = .07^{k}/_{FT}$

{RISK: CANOPY OUTRIG-1.R25}

FOR HSS 4x4x1/4" $\Delta_{CANT} = .33" \Rightarrow (5)(12)(2)/.33 = \ell/360$ OK

$\Delta_{BACK} = .094" \Rightarrow (8.83)(12)/.094 = \ell/1127$ OK

USE HSS 4x4x1/4" @ 3'-6" OC

$R_2 = 2.54^{k}/3.67' = .69^{k}/_{FT}$ ($.35^{k}/_{FT}$ DL, $.33^{k}/_{FT}$ LL) → USE $w = .7^{k}/_{FT}$ ($.35^{k}/_{FT}$ DL, $.35^{k}/_{FT}$ LL)

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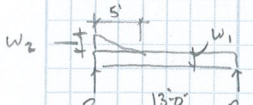
BMS BTWN GRIDS D.1 & D.7:

$\ell = 13'-0"$

$w_1 = (5)(.060) = .3^{k/ft}$ (.25)

$w_2 = (5)(.020) = .1^{k/ft}$



$M = 6.8^{k\cdot ft}$ $S_x = (6.8)(12)/30 = 2.72\ in^3 < 14.9$ OK

$\Delta = .081" \rightarrow \ell/1917$ OK

TRY W12X14

$R_1 = 2.26^k$

$R_2 = 2.07^k/5'-0" = .414^{k/ft}$

CHECK UPLIFT FOR $P_f = 15\ psf$ = USE $w = (5)(.015) = .075^{k/ft}$

$M = (.075)(13)^2/8 = 1.58^{k\cdot ft}$ $f_b = (1.58)(12)/14.9 = 1.27\ ksi < F_b = 1000/(13)(13.3) = 5.78\ ksi$: OK

USE W12X14

{RISA: CANOPY BM - D-1 TO D-7.R2D}

CHECK EDGE BM ALON GRID D.7: (X2 TO 2.3)

$\ell = 33.91'$

$w = .414^{k/ft} + (5)(.010) = .464^{k/ft}$

$M = (.464)(33.91)^2/8 = 66.7\ k\cdot ft$

$S_x = (66.7)(12)/30 = 26.67\ in^3 < 45.6\ in^3$

$\Delta = (.464/12)(5)(33.91\times12)^4/384EI = 476/I = 476/475 = 1.0"$ ← NOTE IF USE TL=50PSF

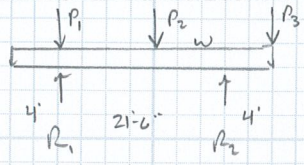
USE W12X58 ↗

$\Delta = 50/60 = .86" \rightarrow (33.91)(12)/.86 = \ell/472$ OK

USE W12X58

$R_1 = R_2 = (.4)(33.91/2) = 6.78^k$

CHECK BM ON GRID "X2"



$w = (29.33 + 3.75)(.5)(.060) = .99^{k/ft}$ $(.5^{k/ft\ DL}, .5^{k/ft\ LL})$ $(w_{up} = (15/60)(.99) = .25^{k/ft})$

$P_1 = (4.5)(29.16)(.5)(.060+.042)(5/8.75) = 3.82^k$ $(1.13^k DL, 2.70^k LL)$ $(P_{up} = .56^k\ up)$

$P_2 = (12.75)(4.5)(.060+.042)(5/8.75) = 3.34^k$ $(.98^k DL, 2.35^k LL)$ $(P_{up} = .49^k\ up)$

$P_3 = 6.78^k$ $(3.39^k DL, 3.39^k LL)$ $(P_{up} = 1.65^k)$

USE W12X40

$\Delta_{1\ CANTI} = .324" \rightarrow (48)(2)/.324 = \ell/296$

$\Delta_2 = .565" \rightarrow (21.5)(12)/.565 = \ell/456$

$\Delta_{3\ CANTI} = .275" \rightarrow (48)(2)/.275 = \ell/349$

{RISA: CANOPY BM - GRID X2.R2D}

→ NOTE Δ's WILL BE LESS IF USE 50PSF TL

$R_1 = 20.09^k$ → (FOR UPLIFT CASE) → $4.14^k\uparrow$

$R_2 = 25.5^k$ → (FOR UPLIFT CASE) → $5.93^k\uparrow$

FTG = $25.5 + (4)(15)(2.67)(.040) = 31.9^{kips}$ → USE HSS 5X5X1/4" $P_{allc} = 66^k > 25.5^k$ OK (KL = 16'-0") OK

FTG = $31.9/2.5^{ksf} = 3.57' \simeq$ USE 4'-0" ⊕ FTG

FTG WT. = $(4)^2(2.67)(.150) = 6.41^k \times .6 = 3.85^k < 5.93^k$

USE 5'-0" ⊕ FTG → $(5)^2(2.67)(.150) = 10.0^k \times .6 = 6.0^k > 5.93^k$ OK

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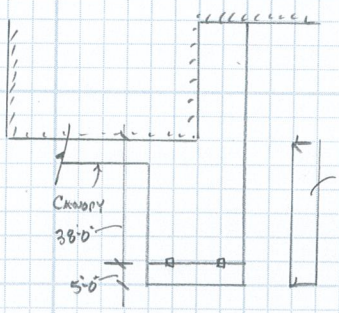
CANOPY FRAME @ "x1"



FROM ASCE 7-16 SECTION 27.3.2

$p = q_h G C_N$ WHERE q_h = 23.27 psf (CONSERV SINCE BASED ON h_{AVE} = 20'-0" & CANOPY IS ONLY @ 15'-0").

G = .85

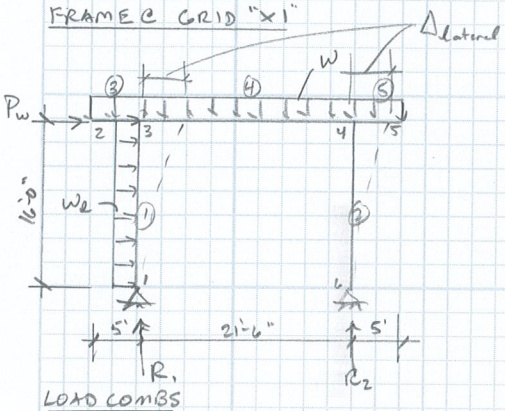
C_N = ±1.2 (WORST CASE)

P = (23.27)(.85)(1.2) = 23.73 x .6 = 14.24 ≈ USE 15psf

* NOTE: USE ONLY DL = 10psf TO RESIST UPLIFT CASES

* USE DL = 20psf, LL = 30psf) FOR CANOPY DESIGN

FRAME @ GRID "x1"



$W_{DL} = [(29.33)(.5) + 5](.020) = .393^{k/ft}$

$W_{LL} = [(29.33)(.5) + 5](.030) = .59^{k/ft}$

$W_{up} = [(29.33)(.5) + 5](.015) = .29^{k/ft}$ ↓↑

$W_L = (3)(.020) = .060^{k/ft}$

$P_w = [(38/2) + 5'-0"](.060^{k/ft}) = 1.44^{kips}$

LOAD COMBS

D+L

D+.75L+.75W

D+W

.6D+W ← UPLIFT FOR WIND

{RISA: CANOPY FRAME X1.R2D}

R_1 = 18.89k (-3.77k ↑)

R_2 = 18.89k (-3.77k ↑)

For HSS 12x6x1/2" COLS & W12x26 BM

$\Delta_{LATERAL} = .577" \Rightarrow (16)(12)(2)/.577 = \ell/665$ OK

$\Delta_{3\,CANT.} = .143" \Rightarrow \ell/839$ OK

$\Delta_4 = .32" \Rightarrow \ell/806$ OK

$\Delta_{5\,CANT.} = .149" \Rightarrow \ell/839$ OK

USE HSS 12x6x1/2 COLS & W12x26 BM

USE 18x12x1 1/4" BASE PL w/ (4) 3/4" ϕ x 2'-6" L. ABS w/ WASH. PL.

For $f_{b\,SOIL}$ = 2500psf P = 18.89 + (7)(2.67)(4)(.040) = 21.88 kips

FTG = $\sqrt{21.88/2.5^{ksf}}$ = 2.95' ≈ USE 3'-6" ϕ FTG ← (USE 4'-0" ϕ FOR UPLIFT)

FOR UPLIFT WT. FTG = (4)²(2.67)(.150) = 6.41k x .6 = 3.84k > 3.77k OK CLOSE

USE 4'-6" x 4'-6" x 2'-8" Dp FTG

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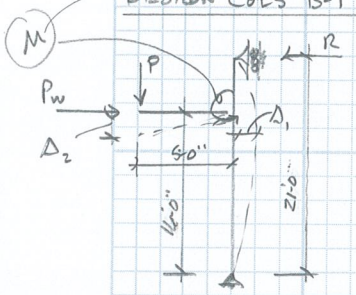
DESIGN COLS B-1 & C-1:



$P = 8.82^k \downarrow$ (DOWNFORCE)

$P = (2.5+1.33)(20)(.015) = 1.15^k \uparrow$ (UPLIFT)

$P_w = (10)(.020)(29.16+20.5)(.5) = 4.96^{kips}$

{RISA: WINDCOLB-1 AND C-1.R2D}

USE HSS 12x8x3/8" COL & HSS 12x8x5/16" OUTRIGGER

$R = 5.87^k$

$M_{COL} = 52.5^{k\text{-}ft}$

$\Delta_1 = .362 \Rightarrow \frac{(21)(12)}{.362} = \ell/696$ OK

$\Delta_2 = .35" \Rightarrow \frac{(5)(12)(2)}{.35} = \ell/342$ OK

NOTE TORSION FROM WINDOW HEAD REACTION ON HSS 20X8 OK – ONLY ADDS 2.1 k-ft OF TORSION & INCREASES $\Delta_1 = .372" \ \ell/677$ OK

CHECK UNITY IN COL FOR AXIAL + FLEXURE (WORST CASE @ C-1)

$M_{max} = 52.5$ k-ft

$P_{max} = 45.9^k$ (REACTION FROM HIGH RF)

$= 8.82^k$ CANT. LOAD FROM EYEBROW

$= (.33^{k/ft})(29.16+20.5)(.5) = 8.19^k$ (REACTION FROM CANOPY BMS @ GRID 1)

} 62.9 kips

UNITY = .78 ≤ 1.0 ($KL = 21'-0"$) → {EXCEL ASTEEL3.XLS}

OK

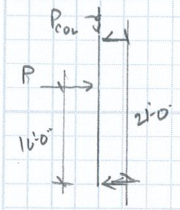
FTG LOAD = $62.9^k + [(5)(15)(.040) = 3^{kips}] = 65.9^k$

FTG = $\sqrt{65.9 / 2.5\ ksf} = 5.13' =$ USE 5'-6" ⌀ FTG

FOR BASE PL (SEE SPREADSHEET)

$t_{REQ} = .72" \Rightarrow$ USE 14x14x1" BASE PL

DESIGN COL @ D.1-1



$P = (10)(.020)(29.16+12.83)(.5) = 4.2^{kips}$

$M = (4.2)(5)(16)/21 = 16^{k\text{-}ft}$

$\Delta = (4.2)(60)(192)(444)\left[(3)(60)(444)\right]^{1/2} / 27EI\ell = 30.77/I = 30.77/85.6 = .359" \Rightarrow \frac{(21)(12)}{.359} = \ell/700$ OK

USE HSS 8x8x5/16" COL

BY INSPECTION OK FOR THIS COLUMN

$P_{max\ COL} = 20.55^k$ (REACTION FROM HIGH RF BM)

$= (.33^{k/ft})(29.16)(.5) = 4.81^k$ (CANOPY BM @ GRID 1)

$= (.435^{k/ft})(25.16)(.5) = 5.47^k$ (CANOPY BM @ GRID D.1)

$= (6.5)(2.5)(.060+.042) = 1.65^k$ CANOPY LD FROM W12X14

$= (4.5)(13)(.060+.042)(.5) = 2.98^k$ CANOPY LD FROM W12X19

} 35.47 k

FOR $P_{max} = 35.47^k$

$M_{max} = 16^{k\text{-}ft}$

($KL = 21'-0"$)

UNITY = .58 ≤ 1.0 OK {ASTEEL4.XLS} → FOR BASE PL (SEE SPREADSHEET)

$t_{REQ} = .54 \Rightarrow$ USE 14x14x1" BASE PL

FTG = $35.47^k + (5)(15)(.040) = 38.47^k \Rightarrow \sqrt{38.47 / 2.5\ ksf} = 3.92' =$ USE 4'-6" ⌀ FTG

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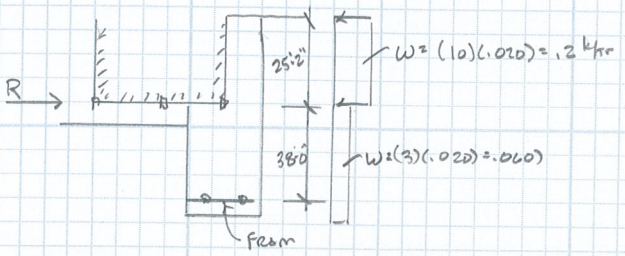
* CHECK COLS B-1, C-1, & D.1-1 FOR EAST-WEST LOAD TRANSFER TO HIGH DIAPHRAGM

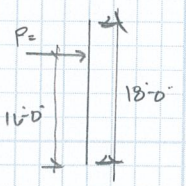


$R = (.2^{k/ft})(25.16'/2) + (.060^{k/ft})(38/2) = 3.65^{kips}$

SINCE $3.65^{kips} < 4.2^{kips}$ AND COLS B-1 & C-1 WILL ALSO RESIST, THEN BY INSPECTION LOAD & Δ's ARE OK

DESIGN LOAD FOR N-S DIRECTION @ COL D.1-1

* CHECK COL DESIGN FOR COLS @ D.1-2.3 & D.7-2.3



$P = (10)(.020)(25.16'/2) = 2.516^{k}/2\ cols = 1.258^{k}$ (EAST WEST WIND LOAD) ← CONTROLS

$P = [(17.5)(.5)(.020) = .175^{k/ft}](13/2) = 1.13^{k}$ (NORTH SOUTH WIND LOAD)

$M = (1.258)(2)(16)/18 = 2.23^{k\cdot ft}$

$P_{max\ col} = (36.83)(.5)(1.75+3.5)(.060) = 5.8^{k}$ HIGH ROOF LOAD

$= (21.58)(23.25)(.25)(.060) = 7.52^{k}$ HIGH ROOF LOAD

$= (.435^{k/ft})(25.16/2) = 5.47^{k}$ CANOPY BM @ GRID D.1

18.8^{kips}

$\Delta = (1.258)(24)(192)(408)\left[(3)(24)(408)\right]^{1/2}/27EI\ell = 2.39/I =$

TRY HSS 6x6x1/4" $I = 28.6\ in^4 \Rightarrow \Delta = 2.39/28.6 = .0837" \Rightarrow \frac{(18)(12)}{.0837} = \ell/2580$ OK

NOTE IF TAKE ALL LOAD @ COL D.1-2.3 $\Delta = (2)(.0837") = .167" \rightarrow \ell/1284$ OK

TRY HSS 5x5x3/16" @ COL D.5-2.3:

$\Delta = (1.13/1.258)(2.39/I) = 2.14/I = 2.14/12.6 = .17" \Rightarrow (18)(12)/.17" = \ell/1270$ OK

$M = (1.13/1.258)(2.23) = 2\ k\cdot ft.$

CHECK UNITY: (AXIAL + FLEXURE)

@ COL D.1-2.3: ~~HSS 6x6x1/4"~~ → change to 8x8x5/16" TO ACCOMODATE HSS 12x8x5/16" BM

$P_{max} = 18.8^{k}$ COL TAKE ALL WIND LOAD

$M_{max} = (2.23)(2) = 4.46^{k\cdot ft}$

$K\ell = 18'-0" \rightarrow$ {ASTEEL5.XLS}

UNITY CHECK = .45 ≤ 1.0 OK

$FTG = \sqrt{18.8/2.5\ ksf} = 2.74' \Rightarrow$ USE 3'-6" ⊕ FTG

USE 12x12x1" BASER

@ COL D.7-2.3: HSS 5x5x3/16" USE 1/4" FOR BETTER CONNECTION

$P_{max} = (.464^{k/ft})(33.91/2) = 7.87^{k}$

$M_{max} = 2^{k\cdot ft}$

$K\ell = 18'-0" \rightarrow$ {ASTEEL6.XLS}

UNITY CHECK = .27 ≤ 1.0 OK

$FTG = \sqrt{7.87/2.5\ ksf} = 1.77' \Rightarrow$ USE 3'-0" ⊕ FTG

USE 11x11x1" BASER

BY INSPECTION 1" THK BASER OK

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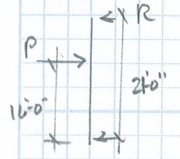
DESIGN COL @ B-2:



$P = (16)(.020)(36.83)(.5) = 3.68^{kips}$ $R = 3.68^{k}$ (CONSERV.)

$M = (3.68^{k})(5)(16)/21 = 14.03^{k\text{-}ft}$

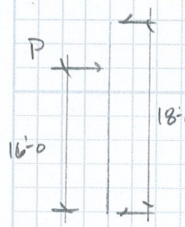
BY INSPECTION OF COL @ D.1-1: USE HSS 8x8x5/16"

$P_{max} = (36.83)(.5)(1.75+3.5)(.060) = 5.80^{k}$ (HIGH RF BM)
$= [.18^{k/ft} + (5)(.010)](36.83)(.5) = 15.85^{k}$ (LOW RF BMS ON GRID B)
} 21.45^{kips}

SINCE P_{max} & M_{max} ARE LESS THAN COL @ D.1-1, BY INSPECTION USE HSS 8x8x5/16" OK
↑ USE SAME 14x14x1" BASE Pl

$FTG = \sqrt{21.45^{k}/2.5^{ksf}} = 2.92' =$ USE 3'-0" ϕ FTG

DESIGN COL @ A.2-3.5 & B-3.5



$P = (10)(.020)(16.33/2) = 1.63^{kips}/2\ COLS = .816^{kips/COL}$ (EAST-WEST WIND LOADS)

$M = (.816)(2)(16)/18 = 1.45^{k\text{-}ft} < 2.23^{k\text{-}ft}$

NOTE: BY COMPARISON TO COL @ D.1-2.3, FLEXURE LOADING IS LESS

USE HSS 6x6x1/4"

CHECK AXIAL + FLEXURE (UNITY CHECK)

DETERMINE COL LOADS

@ A.2-3.5: $P_{max} = (11.58)(16.67)(.25)(.060) = 2.89^{k}$ (HIGH ROOF)
$= (23)(16.67)(.5)(.060+.035)$ (DRIFT) $= 18.21^{kips}$ (LOW RF CANOPY LD)
$= (14.75)(2.5)(.060+.035) = 3.5^{kips}$ (LOW RF CANOPY LD)
$= (16.5+5)(.5)(5)(.010) = .53^{kips}$ (WALL BTWN LOW & HIGH RF)
25.14^{kips}

@ B-3.5: $P_{max} = (11.58)(16.67)(.25)(.060) = 2.89^{k}$ (REACTION FROM W14x22 ON GRID 3.5)
$= 15.77^{k}$ (REACTION FROM W27 BM ON GRID 3.5)
$= [.18^{k/ft} + (5)(.010)](16.33)(.5) = 6.94^{k}$
$= (5)(.010)(16.5)(.5) = .4125^{k}$
26.01^{k}

UNITY CHECK {ASTEEL7.XLS}

$P_{max} = 26^{k}$
$M_{max} = 1.45^{k\text{-}ft}$
$(KL = 18'-0")$
} FOR HSS 6x6x1/4"
UNITY = .38 ≤ 1.0 OK

CHECK NORTH/SOUTH WIND LOAD AGAINST COL (SEE NEXT PAGE)

BRICK
$FTG = 26 + (4)(18)(.040) = \sqrt{28.89/2.5^{ksf}} = 3.39' =$ USE 4'-0" ϕ FTG

FOR 12x12 BASE Pl $t_{req'd} = .51" =$ USE 1"

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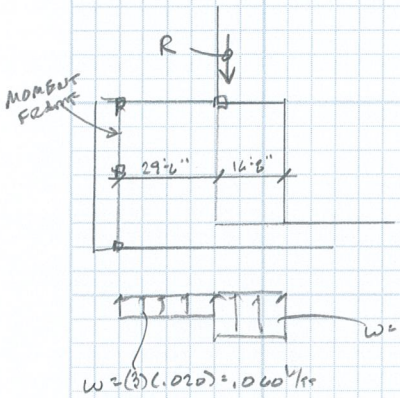
CHECK COL @ A.2-3.5 FOR NORTH-SOUTH LOAD:



$R = (29.5)(.5)(.060) + (16.67)(.5)(.2\,k/ft) = 2.55\,k$

$M = (2.55)(2)(16)/18 = 4.54\,k\cdot ft$

$\Delta = (2.55/1.258)(2.39/I) = 4.84/I = 4.84/28.6 = .169" \Rightarrow \frac{(18)(12)}{.169} = \ell/1275$ OK

CHECK UNITY FOR

$P_{max} = 26^k$
$M_{max} = 4.54\,k\cdot ft$
$KL = 18'-0"$

UNITY = .56 ≤ 1.0 OK

Summary: @ COL A.2-3.5 & B-3.5

USE HSS 6x6x1/4"
12x12x1" BASE PL
USE 4'-0" Ø FTG

COLUMN &
FOUNDATION DESIGN

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COLUMN/FTG RUNDOWN DESIGN {NOTE ADD (4)(18)(.040) = 2.88^k BRICK LOAD TO FTG LOADS}

A.2-8:
P = 14.08^k + 2.88^k = 16.96^k USE HSS 5x5x3/16" P_{allow} = 43^k > 14.08^k OK (KL = 18'-0") OK
FTG = $\sqrt{16.96^k / 2.5\,ksf}$ = 2.60' = USE 3'-0" ⌀ FTG

C-8: (SEE BRACING CALCS)

D-8: (SEE BRACING CALCS)

D.8-8 (SEE BACK CANOPY CALCS)

F-8 (SEE BACK CANOPY CALCS)

D.8-7 (SEE BACK CANOPY CALCS)

F-7 (SEE BACK CANOPY CALCS)

G-7 (SEE BACK CANOPY CALCS)

H-7: P = 14.89^k + 2.88^k = 17.77^k USE HSS 5x5x3/16" P_{allow} = 43^k > 14.89^k (KL = 18'-0") OK
FTG: $\sqrt{17.77 / 2.5\,ksf}$ = 2.67' = USE 3'-0" ⌀ FTG

A.2-6 P = 26.2^k + 2.88^k = 29.08^k USE HSS 5x5x1/4" P_{allow} = 60^k > 26.2^k (KL = 17'-0") OK
FTG = $\sqrt{29.08 / 2.5\,ksf}$ = 3.41' = USE 4'-0" ⌀ FTG

C-6: P = 56.1^k → USE HSS 5x5x5/16" P_{allow} = 72^k > 56.1^k OK (KL = 17'-0")
FTG = $\sqrt{56.1 / 2.5\,ksf}$ = 4.73' = USE 5'-0" ⌀ FTG

D-6 (SEE BRACING CALCS)

E-6 P = 13.6^k + (32.75)(.5)(2.5)(.060) = 16.05^k → USE HSS 5x5x1/4" P_{allow} = 60^k > 16.05^k OK
FTG = $\sqrt{16.05^k / 2.5\,ksf}$ = 2.53' = USE 3'-0" ⌀ FTG
USE 3'-6" ⌀ FTG

A.2-3.7: P = [(2.5+1.33)(.060) + (5)(.010)](29.5)(.5) = 4.12^k
= (5)(.010)(2.5+1.33) = .19^k
4.31^k ← BY INSPECTION USE HSS 5x5x1/4" (SAME AS COLE D.7-2.3)

XA-3.5:
XA-1.5:
XA-1:
SEE MAIN CANOPY CALCS – CANOPY FRAME

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A.2-3.5: (SEE MAIN CANOPY CALCS)

B-3.5: (SEE MAIN CANOPY CALCS)

C-3.5: $P = 51.7^k$ (BM REACTION) – USE HSS 5x5x3/16" $P_{nc} = 64^k > 51.7^k$ OK (KL = 18'-0") FTG = 51.7 / 2.5 ksf = 4.54' → USE 5'-0" ⌀ FTG

D.1-3.5 $P = 22.44^k$ (BM REACTION) – USE HSS 5x5x1/4" $P_{nc} = 54^k > 22.44^k$ OK (KL = 18'-0") FTG = 22.44 / 2.5 ksf = 2.99' → USE 3'-6" ⌀ FTG

A-2: $P = (1.42^k/ft)(20.5+16.33)(.5) = 26.149^k$
$= (15)(4)(.040) = 2.4^k$
$28.54^k \leftarrow$ USE HSS 5x5x3/16"
$P_{nc} = 56^k > 26.14^k$ OK (KL = 15'-0") FTG = 28.54 / 2.5 ksf = 3.37' → USE 4'-0" ⌀ FTG

A-1: $P = (1.42^k/ft)(20.5)(.5) = 14.55^k$
$= (15)(4)(.040) = 2.4^k$
$= 6.43^k$ (CANT. LOAD)
$23.38^k \leftarrow$ USE HSS 5x5x3/16"
$P_{nc} = 56^k > 23.38^k - 2.4^k = 20.98^k$ OK (KL = 15'-0")
FTG = 23.38 / 2.5 ksf = 3.05' → USE 3'-6" FTG.

B-2:
B-1:
C-1:
D.1-1:
D.1-2.3:
D.7-2.3: } (SEE MAIN CANOPY CALCS)

C.5-x1: } SEE MAIN CANOPY CALCS - MAIN CANOPY FRAME.
D.5-x1: }

E-3: $(23.25)(21.58)(.25)(.060) = 7.52^k$
$= 7.90^k$ (REACTION FROM BM @ GRID 3)
$15.42^k \leftarrow$ USE HSS 5x5x3/16"
$P_{nc} = 43^k > 15.42^k$ OK (KL = 18'-0")
FTG = 15.42 / 2.5 ksf = 2.48' → USE 3'-6" ⌀ FTG

F-3: (SEE BRACING CALCS)
G-3: (SEE BRACING CALCS)

H-3: $P = 11.44^k + (4)(18)(.040) = 14.54^k$ (4 @ GRID) ← USE HSS 5x5x3/16"
$P_{nc} = 43^k > 14.54^k$ OK (KL = 18'-0")
FTG = 14.54 / 2.5 ksf = 2.41' → USE 3'-0" ⌀ FTG

(SEE BRACING CALCS)

C.5-x2: } (SEE MAIN CANOPY CALCS)
D.5-x2: }

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GRID 4 & 5 COL & FTG SIZE:

A.2-5: (SEE BRACING CALCS)

C-5: 66.2^k
D-5: 70.6^k
E-5: 65.8^k

(USE Kl=17'-0") USE HSS 5x5x3/8" P_{nc} = 82^k > 70.6^k OK

FTG = $\sqrt{66.2/2.5\,ksf}$ = 5.14' → USE 5'-6" ⌀ FTG

$\sqrt{70.6/2.5\,ksf}$ = 5.31' → USE 6'-0" ⌀ FTG

$\sqrt{65.8/2.5\,ksf}$ = 5.13' → USE 5'-6" ⌀ FTG

FOR P_{max} = 70.6^k & 11x11 BASE ℄ → $t_{req'd}$ = .89" = USE 1" THK → USE 11x11x1" BASE ℄

F-5: (SEE BRACING CALC)

G-5: P= 68^k (USE Kl=17'-0") USE HSS 5x5x3/8" P_{nc} = 82^k > 70.6^k OK

FTG = $\sqrt{68/2.5\,ksf}$ = 5.21' → USE 5'-6" ⌀ FTG

H-5 P= 27.93^k (USE Kl=17'-0") USE HSS 5x5x1/4" P_{nc} = 60^k > 27.93^k OK

FTG = $\sqrt{27.93^k/2.5\,ksf}$ = 3.34' = USE 4'-0" ⌀ FTG

BY INSPECTION USE 11x11x1" BASE ℄

A.2-4 (SEE BRACING CALCS)

C-4: 49.1^k
D-4: 48.8^k
E-4: 45.32^k

(USE Kl=17'-6") USE HSS 5x5x5/16" P_{nc} = 68^k > 49.1^k OK

FTG $\sqrt{49.1/2.5\,ksf}$ = 4.43' → USE 5'-0" ⌀

$\sqrt{48.8/2.5\,ksf}$ = 4.41' → USE 5'-0" ⌀

$\sqrt{45.32/2.5\,ksf}$ = 4.25' → USE 5'-0" ⌀

E-4 : (SEE BRACING CALC)

G-4: 55^k (USE Kl=17'-6") USE HSS 5x5x5/16" P_{nc} = 68^k > 55^k OK

FTG = $\sqrt{55/2.5\,ksf}$ = 4.69' = USE 5'-0" ⌀ FTG

H-4 (SEE BRACING CALC)

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DESIGN FTG REINF: $f_{brg} = 2500 psf$

FOR 6'-0" ϕ x 1'-4" Dp FTG.

$M_u = (1.7)(2.5)(3)^2/2 = 19.125^{k\text{-}ft}$

$A_s = (19.125)(12)/(12)(54) = .35 in.^2 \times 1.33 = .47 in.^2 \leftarrow$ USE #5 @ 6" OC $A_s = .62 in^2/ft > .47 in^2$ OK

FOR 4'-6" x 4'-6" x 1'-4" Dp FTG (SAME FOR SMALLER FTGS)

$M_u = (1.7)(2.5)(2.25)^2/2 = 10.75^{k\text{-}ft}$

$A_s = (10.75)(12)/(12)(54) = .2 in^2/ft \times 1.33 = .26 in^2/ft \leftarrow$ USE #4 @ 6" OC $A_s = .4 in^2/ft > .26 in^2$ OK

FOR 6'-0" ϕ x 2'-8" Dp FTG

$M_u = 19.125^{k\text{-}ft}$

$A_s = (19.125)(12)/(28)(54) = .15 in^2/ft \times 1.33 = .20 in^2/ft \leftarrow$ #4 @ 6" OC $= .4 in^2/ft > .2 in^2/ft$ OK

FOR 4'-0" x 8'-6" x 2'-8" Dp FTG

- BY INSPECTION, #4 @ 6" OC OK FOR SHORT DIRECTION

LONG DIR:

$M_u = (1.7)(2.5)(4.25)^2/2 = 38.38^{k\text{-}ft}$

$A_s = (38.38)(12)/(28)(54) = .30 in^2/ft \times 1.33 = .405 in.^2 \leftarrow$ USE #5 @ 6" OC $A_s = .62 in^2/ft > .405 in^2/ft$ OK

MISC MEMBER DESIGN

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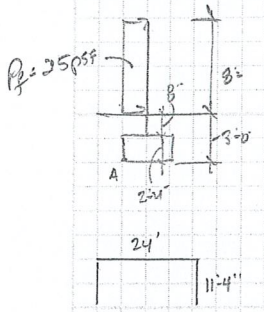
TRASH ENCLOSURE (PER SEC 29.3 OF ASCE 7-16) $P_f = q_z G C_f$ WHERE $q_z = 21.98$ psf (SAME AS MECH. YARD)

$G = .85$

$C_f = 2.60 \times (1.3 - 1.0) = 2.08$



$s/h = 1.0$

$B/s = 11.33/8 = 1.41$ } $C_f = 1.43$ (CASE A OR B)

$s/h = 1.0$

$B/s = 24/8 = 3.0$ } $C_f = 2.60$ (CASE C)

$P_p = (21.98)(.85)(2.08)(.6) = 23.31 \approx$ USE 25 psf

$M_d = (.025)(8)(8/2 + .67) = .934^{k\text{-ft}}/_{ft}$

* USING 8" CMU REINF w/ (1) - #5 @ 24" oc

$f_s = (2)(.934)(12) / (3.5")(.31 in^2) = 20.66$ ksi $<$ 24 ksi OK

$\rho = A_s/bd = .31/(24)(3.5) = .00369$ $\quad n = 16.11$

$k = \left\{[(16.11)(.00369)]^2 + (2)(16.11)(.00369)\right\}^{1/2} - (16.11)(.00369) = .29$

$j = 1 - .29/3 = .903$

$f_b = (2)(.934)(12) / (24)(3.5)^2(.903)(.29)(.5) = 581$ psi $<$ 666 psi OK

USE (1) - #5 @ 24" oc

CHECK PTG DESIGN ($f_{brg} = 2500$ psf)

CHECK OVERTURNING: (.6D + W)

$M_{OT} = (.025)(8)(8/2 + 3) = 1.4^{k\text{-ft}}$

TRY 3'-6" x 2'-4" Dp GR BM $\quad P_W = (3.5)(2.33)(.150) = 1.22^{k}/_{ft}$

$M_R = \left\{1.22 + [(8.67)(.060) = .52^{k}/_{ft}] = 1.74^{k}/_{ft}\right\} \times (1.75) \times .6 = 1.83^{k\text{-ft}}/_{ft} > 1.4^{k\text{-ft}}$ OK

CHECK SOIL STRESS

$P/A = 1.74^{k}/_{ft} + (8.67)(.040)/3.5' = 596$ psf

$M = 1.4^{k\text{-ft}}$ $\quad S_{ftg} = (3.5)^2/6 = 2.04\ ft^3$ $\quad M/S < 1.4/2.04 = 606$ psf > 596 psf

$M/P = 1.4^{k\text{-ft}}/1.74^{k} = .804 = e \Rightarrow \bar{x} = 1.75' - .804 = .945' = \bar{x}$

$Q = 1.74 + .35 / (8)(.5)(.945) = 1.47$ ksf $<$ 2.5 ksf OK

USE 3'-6" x 2'-4" GR BM

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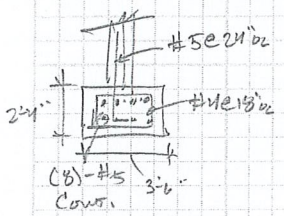
SIZE FTG REINF.

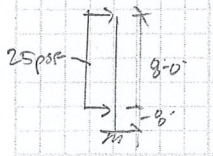
$M_u = (1.7)(2.5)(2)^2/2 = 8.5^{k\text{-ft}}$

$(d \approx 24") \Rightarrow A_s = (8.5)(12)/(24)(54) = .0787 \times 1.33 = .10\ in^2/ft \Rightarrow$ USE #4@18" OC STIRRUPS

HORIZ. STEEL = $(.0018)(28)(48) = 2.42\ in^2$ FOR (8)#5 (1 1/2 TYP) $\Rightarrow A_s = (8)(.31) = 2.48\ in^2 > 2.42\ in^2$ OK



SIZE GATE POSTS:



$M = (8)(.025)(4.67) = .934^{k/ft} \times 12'\text{-}0" = 11.2^{k\text{-ft}}$

$S_n = (11.2)(12)/(.6)(46) = 4.87\ in^3 < 7.42\ in^2$ OK FOR HSS 6x6x3/16"

$\Delta = (12)\left(\frac{.025}{12}\right)(8.67\times12)^4/8EI = 12.65/I = 12.65/28.6 = .44" \Rightarrow \frac{(8.67)(12)(12)}{.44} = \ell/471$ HSS 6x6x1/4"

$12.65/22.3 = .56" \Rightarrow \frac{(8.67)(12)(12)}{.56} = \ell/371$ HSS 6x6x3/16"

USE HSS 6x6x3/16" GATE POST

CHECK FTG: @ CENTER POST: USE 5'-6"ϕ x 2'-4" D WT = 10.58^{k}

$M_{DT} = (8)(.025)(7)(12) = 16.8^{k\text{-ft}}$

$M_u = (10.58)(2.75)(.6) = 17.46^{k\text{-ft}} > 16.8^{k\text{-ft}}$ OK

FOR 5'-6"ϕ x 2'-4" FTG.

$P/A = 10.58/(5.5)^2 = 350\ psf$

$M/S = 16.8/S = (5.5)^3/6 = 27.72 = 605\ psf$

$M/P = 16.8/10.58 = e = 1.58' \Rightarrow \bar{x} = 2.75' - 1.58' = 1.16'$

$Q = 10.58/(3)(5)(1.16') = 6.06/5'\text{-}6" = 1.1\ ksf < 2.5\ ksf$ OK

FTG REINF: $M_u = (1.7)(2.5)(2.75)^2/2 = 16.07^{k\text{-ft}}$

$A_s = (16.07)(12)/(24)(54) = .15\ in^2/ft^2 \times 1.33 = .20\ in^2 \Rightarrow$ USE #4@6" OC BOT; USE #4@12" OC TOP

5'-6"ϕ x 2'-4" D FTG

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CHECK END POST

$M_{DL} = (.934^{k/ft}) \times 6'\text{-}0" = 5.6^{k\text{-}ft}$ ← USE HSS 6X6X3/16" GATE POST SAME AS CENTER

FOR 4'-0" ϕ x 2'-4" FTG: $P_W = (4)(4)(2.33)(.150) = 5.6^{kips}$

$M_{DL} = (8)(.025)(7)(6) = 8.4^{k\text{-}ft}$

$M_R = (5.6)(2)(.6) = 6.72^{k\text{-}ft}$ ← USE 4'-6" ϕ FTG $P_W = (4.5)^2(2.33)(.150) = 7.08^{k}$

$M_R = (7.08)(2.25)(.6) = 9.55^{k\text{-}ft} > 8.4^{k\text{-}ft}$ OK

$P/A = 7.08^{k}/(4.5)^2 = 350 \cdot psf$

$S_{FTG} = (4.5)^3/6 = 15.18\ ft^3$

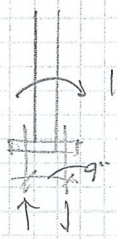
$M/S = 8.4/15.18 = 553\ psf > P/A$

$M/P = 8.4^{k\text{-}ft}/7.08^{k} = 1.19' = e \quad \bar{x} = 2.25' - 1.19' = 1.06'$

$Q = 7.08^{k}/(3)(1.5)(1.06') = 4.45^{k}/4.5' = 1000\ psf < 2000\ psf$ OK

USE 4'-6" ϕ x 2'-4" FTG ← REINF W/ #4@6" BOT & #4@12" OC TOP SAME AS CENTER FTG

CHECK BASE R & AB DESIGN @ BASE



$T = C = (11.2)(12)/9" = 14.93^{k}/2\ BOLTS = 7.5^{k} < 8.4^{k}/BOLT$ OK FOR 3/4" ϕ
BUT USE 1" ϕ BOLTS

CHECK R MOMENT:

$M_R = (14.93)(1.5") = 22.4^{k\text{-}in.}$

$S_R = \frac{9}{6}(1)^2 = 1.5$

$f_b = 22.4^{k\text{-}in}/1.5\ in^3 = 14.93\ ksi < 27\ ksi$ OK

CHECK COL WELD TO BASE R

$M = (11.2)(12) = 134.4^{k\text{-}in.}$

$S_{weld} = (6)(6) + (6)^2/3 = 48\ in^3$

$M/S = 134.4/48 = 2.8^{k/in}$

$V = (8)(.025)(12) = 2.4^{k}/(6)(4) = .1^{k/in.}$

$f_r = \left[(2.8)^2 + (.1)^2\right]^{1/2} = 2.80^{k/in}$

USE HSS 6X6X1/4" POST W/ 1/4" FILLET WELD ALL AROUND & 14X14X1" BASE R & (4) 1" ϕ A36 BOLTS X 2'-6" LG. W/ 6" PROJ.

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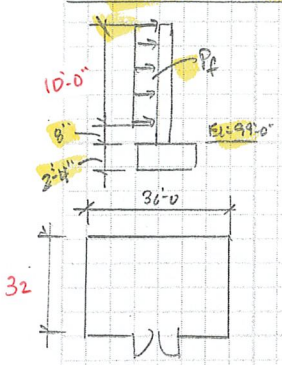
DESIGN MECH YARD WALLS: (PER SEC 29.3 OF ASCE 7-16) $P_p = q_z G C_F$ WHERE $q_z = 25.85 K_z$ WHERE $K_z = .85$

$= (25.85)(.85) = 21.98$ psf



$S/h = 10./10 = 1.0$

$B/s = 324/10 = 3.2$

$G = .85$

$C_F = 1.37$ (CASE A & B)

$= 2.66 \times (1.8 - 1.03) = 2.13$ (case c)

$P_p = (21.98)(.85)(2.13)(1.6) = 23.87$ psf $\approx$ USE 25 psf

$M = (.025)(10')(10/2 + .67) = 1.42$ k-ft/ft

USING 8" THK BLOCK: w/ (1) #5 @ 8" oc (d = 3.5")

$M = (1.42)(.67) = .951$ k-ft

$f_s = (951)(12)/(3.5)(.31) = 10.52$ ksi < 24 ksi OK

$\rho = A_s/bd = .31/(8)(3.5) = .0111$

$n = 16.11$ ($f'm = 2000$ psi)

$k = \{[(16.11)(.0111)]^2 + (2)(16.11)(.0111)\}^{1/2} - (16.11)(.0111) = .445$

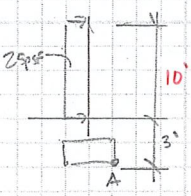
$j = 1 - .445/3 = .852$

$f_b = (951)(12)/(8)(3.5)^2(.852)(.445)(.5) = 614$ psi $\approx .33 f'm = .33(2000) = 666$ psi OK

USE 8" CMU w/ (1) #5 @ 8" oc (1/2 EF)

CHECK FTG DESIGN ($f_{brg} = 2500$ psf)

CHECK OVERTURNING (.6D + LR)



$M_{OT} = (.025)(10')(10/2 + 3) = 2.0$ k-ft/ft

TRY 4'-6" x 2'-4" Dp FTG: $P_W = (4.5)(2.33)(.150) = 1.57$ k/ft

$M_R = (1.57)(2.25)(.6) = 2.12$ k-ft/ft > 2.0 OK

(10.67) +

CHECK SOIL STRESS:

$P/A = [(10.67)(.065 + .040) + 1.57 \text{ k/ft} = 2.69 \text{ k/ft}]/4.5' = 597$ psf

$S_{FTG} = (4.5)^2/6 = 3.375$ ft^3

$M = 2.0$ k-ft/ft $\Rightarrow M/S = 2.0/3.375 = 592$ psf $< P/A$

$\therefore M/S + P/A = 597 + 593 = 1190$ psf < 2500 psf OK

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SIZE FTG REINF.

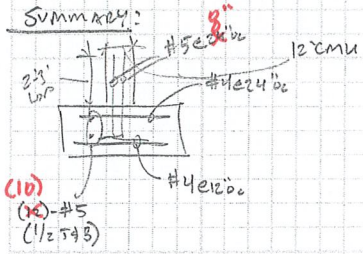
$M_u = (1.7)(2.5)(2.25)^2/2 = 10.75$ k-ft

$(d = 24")$ $A_s = (10.75 \text{ k-ft})(12)/(24)(54)^2 = .101 \text{ in}^2 \times 1.33 = .132 \text{ in}^2$ → USE #4@12" o.c.

LONG REINF.

$A_s = (.0018)(28)(54) = 2.72 \text{ in}^2$ USE (10)-#5 (1½ T&B) → $A_s = (10)(.31) = 3.10 \text{ in}^2 > 2.72 \text{ in}^2$ OK

SUMMARY:



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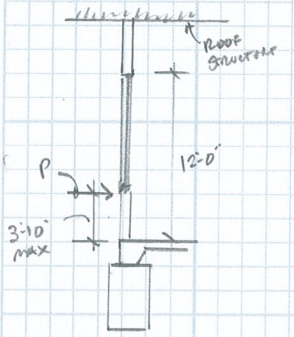
CHECK CHANNEL SILL SUPPORT



$P = (12/2)(.020) = .12^k/ft$

USE CHANNELS @ 48" o.c.

$P = (.12^k/ft)(4) = .48^k$

$M = (.48^k)(3.83) = 1.83^{k\text{-}ft}$

$f_b = (1.83)(12)/1.93 = 11.43$ ksi

$F_b = 1000/(8.52)(8) = 14.67$ ksi > 11.43 ksi OK

$\Delta = (.48)(46)^3/3E1 = .53/I = .53/3.85 = .139" \Rightarrow (46)(2)/.139 = l/659$ OK

CHECK WELD TO EMBED $S_{WELD} = (1.625)(4) + (4)^2/6 = 9.16\ in.^3$ (C4x5.4)

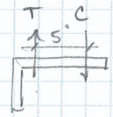
$(1.75)(5) + (5)^2/6 = 12.91\ in.^3$ (C5x6.7)

$f_x = (1.83)(12)/9.16 = 2.39^k/in.$

$f_y = .48^k/4 = .12^k/in.$

$\left[(2.39)^2 + (.12)^2\right]^{1/2} = 2.39^k/in.$ ← USE 3/16" FILLET WELD

(USE C5x6.7 @ 48" o.c. FOR ADDED STIFFNESS)



$T = C = (1.83)(12)/5 = 4.39^k$ ← BY INSPECTION OK FOR DWLS + STUDS

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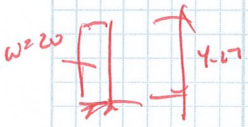

$M = (.020)(4.67)^2/2 = .218^{k/ft}/ft \quad .582^{k/ft}$

$f_s = (.582)(12)/(.35)(.31) = 6.44 \text{ ksi} < 24 \leftarrow$ USE @ 48" oc

COURTYARD CMU WALL

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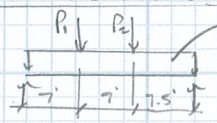
CHECK JSTS FOR EQUIP BOOMS & LIGHTS

OPERATING ROOMS:



$w = (5)(.060) = .3^{k/ft}$

$P_1 = 265^{\#} \rightarrow 1.1^{k}$ (LIGHT)

$P_2 = 1250^{\#} \rightarrow 1.1^{k}$ (BOOM)

$M_u = 23^{k\text{-ft}} \times 12 = 276^{k\text{-in}}$

$V = 4.112^{k}$

{RISK: OR BOOM JST, R20}

USE 16KCS3 JST $M_{nc} = 470^{k\text{-in}} > 276^{k\text{-in}}$ OK

$V_{nc} = 4.8^{kips} > 4.112^{k}$ OK

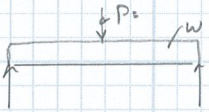
→ {NOTE IF BOTH MOUNTS ARE STRYKER BOOMS (MAX WT. = 1100#)

$P_1 = P_2 = 1.1^{k}$

$M = 25^{k\text{-ft}} \times 12 = 300^{k\text{-in}} < 470^{k\text{-in}}$ OK

$V = 4.35^{k} < 4.8^{k}$ OK {16KCS3 JST STILL OK}

GI PROCEDURE ROOMS



$w = (5)(.060) = .3^{k/ft}$

$P = 500^{\#} \rightarrow 1.1^{k}$

$M = (.3)(25.25)^2/8 + (1.1)(25.25)/4 = 27.06^{k\text{-ft}} \times 12 = 324.7^{k\text{-in}}$ → 30.85 → 370.2

$V_{max} = (.3^{k/ft})(25.25/2) + 1.1^{k} = 4.29^{kips}$ → 4.88

WORST CASE ADD TO TOTAL SITEAR LOAD

USE 20KCS2 JST $M_{nc} = 442^{k\text{-in}} > 324.7^{k\text{-in}}$ → 370.2 OK

$V_{nc} = 5.2^{k} > 4.29^{k}$ → 4.88 OK