ODOC SALEM - HVAC

3405 Deerpark Dr SE
Salem, OR 97310

STRUCTURAL CALCULATIONS

VLMK Project Number: 20210146

MFIA Inc. Consulting Engineers
2007 SE Ash St
Portland, OR 97214

STRUCTURAL
REGISTERED PROFESSIONAL
ENGINEER
OREGON
TRENT C. NAGELE
7/12/2021
EXPIRES: 12/31/2022

Prepared By: Ryan Kelly, P.E.
July 12, 2021

VLMK
ENGINEERING + DESIGN

Project:	ODOC Salem - HVAC	*Project Number:*	20210146
Project Address:	3405 Deerpark Dr SE Salem, OR 97310	*Document:*	Structural Calculations for Building Permit

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DESCRIPTION OF PROJECT

This 'ODOC Salem - HVAC' consists of the design of a new concrete pad to support (1) new HVAC unit at the site located at 3405 Deerpark Dr SE, Salem, OR 97310. Anchorage calculations are provided for the equipment to be secured to the concrete pad to withstand wind and seismic forces.

LIMITATIONS

VLMK Engineering + Design was retained in a limited capacity for this project. No responsibility and/or liability is assumed by, nor is any to be assigned to, VLMK Engineering + Design for items beyond that shown in this Structural Calculation Package.

CODES

2019 Oregon Structural Specialty Code (Based on the 2018 International Building Code)

DESIGN LOADS

Dead Loads

Additional Loads

Valent Mechanical Unit	4,550 lbs

Wind

Basic Design Wind Speed, V (3-sec gust)	104 mph
Nominal Design Wind Speed, V_{asd}	81 mph
Risk Category	III
Wind Exposure	B
Internal Pressure Coefficient	GC_{pi} = +/- 0.18

Seismic

Location	Latitude	44.896887
	Longitude	-122.948908
Seismic Importance Factor, I_e		1.25
Risk Category		III
Mapped Spectral Response Accelerations		S_s = 0.787
		S_1 = 0.396
Site Class		D (Default)
Spectral Response Coefficients		S_{ds} = 0.630
		S_{d1} = 0.503
Seismic Design Category		D

Component Anchorage Factors	a_p	R_p	I_p	Ω_o
HVAC Equip	2.5	6.0	1.0	2.0

ATC Hazards by Location

Search Information

Coordinates: 44.896887, -122.948908

Elevation: 259 ft

Timestamp: 2021-05-21T00:34:54.557Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: II

Site Class: D-default

Basic Parameters

Name	Value	Description
S_S	0.787	MCE_R ground motion (period=0.2s)
S_1	0.396	MCE_R ground motion (period=1.0s)
S_{MS}	0.945	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	0.63	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

*
S_{D1} = 2/3 S_{M1} = 0.503
S_{M1} = $F_v S_1$ = 0.754
F_v = 1.904 Table 11.4-2

Seismic Design Category: D

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.88	Coefficient of risk (0.2s)
CR_1	0.862	Coefficient of risk (1.0s)
PGA	0.364	MCE_G peak ground acceleration
F_{PGA}	1.236	Site amplification factor at PGA
PGA_M	0.45	Site modified peak ground acceleration
T_L	16	Long-period transition period (s)

Hazards by Location

Search Information

Coordinates:	44.896887, -122.948908
Elevation:	259 ft
Timestamp:	2021-05-21T00:36:42.246Z
Hazard Type:	Wind

ASCE 7-16

MRI 10-Year	66 mph
MRI 25-Year	72 mph
MRI 50-Year	76 mph
MRI 100-Year	81 mph
Risk Category I	90 mph
Risk Category II	96 mph
Risk Category III	102 mph
Risk Category IV	107 mph

ASCE 7-10

MRI 10-Year	72 mph
MRI 25-Year	79 mph
MRI 50-Year	85 mph
MRI 100-Year	91 mph
Risk Category I	100 mph
Risk Category II	110 mph
Risk Category III-IV	115 mph

ASCE 7-05

ASCE 7-05 Wind Speed	85 mph

104 mph per 2019 OSSC

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

Disclaimer

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

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

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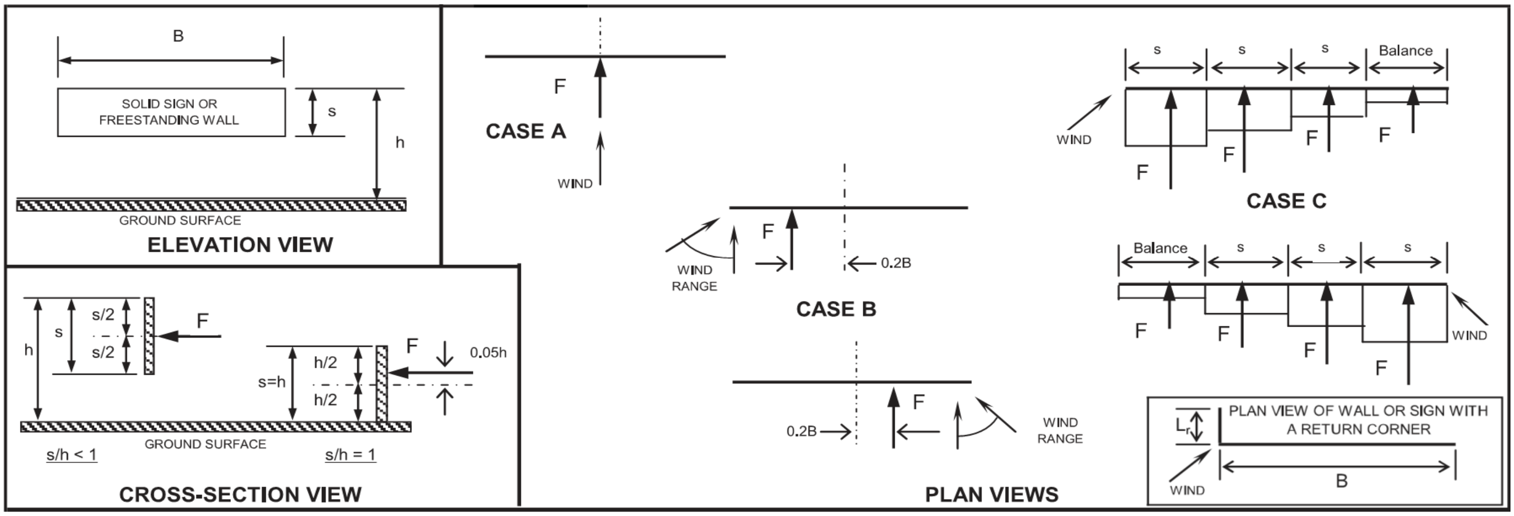
Wind Loads on Solid Freestanding Walls and Solid Signs

Based on the 2018 International Building Code and ASCE 7-16 Section 29.3.1



DESIGN INPUT

Exposure	B		Exposure category	[Section 26.7.3]
K_{zt} =	1.00		Topographic factor	[Section 26.8]
V =	104	mph	Ultimate wind speed (3-second gust)	[Figures 26.5-1A, B, and C]
h =	6.5	ft	Height from ground level to top of sign or wall	[Figure 29.3-1]
s =	6.5	ft	Vertical dimension of sign	[Figure 29.3-1]
B =	13.67	ft	Horizontal dimension of sign or wall	[Figure 29.3-1]
L_r =	0	ft	Horizontal dimension of return corner or wall	[Figure 29.3-1]
A_o =	0	ft	Total area of openings	[Figure 29.3-1]
	Side Support		If h ≤ 3 feet, use Components and Cladding design provisions.	
B_{post} =	1	in	NA, no supporting posts for walls or side supported signs	
Load Factor =	1.0		Ultimate = 1.0W loads, ASD = 0.6W loads	

ANALYSIS

A_{sign} =	88.855	ft	gross area of wall or sign normal to wind direction	
A_{post} =	0	ft	area of post(s)	
ε =	1.00		ratio of solid area to gross area	[Figure 29.3-1]
R.F. =	1.00		reduction factor for openings *Reduction Factor = $1-(1-\varepsilon)^{1.5}$*	[Figure 29.3-1]
K_h =	0.57		velocity pressure exposure coefficient	[Section 26.10]
K_d =	0.85		wind directionality factor	[Table 26.6-1]
K_e =	1.00		ground elevation factor	[Table 26.9-1]
q_h =	16.0	psf	velocity pressure $q_h = 0.00256 K_h K_{zt} K_d K_e V^2$	(Equation 26.10-1)
G =	0.85		gust effect factor, 0.85 for rigid structure	[Section 26.11.1]
C_f =	1.40		sign force coefficient for Cases A & B	[Figure 29.3-1]
C_f =	1.49		average sign force coefficient for Case C	[Figure 29.3-1]

(1.0W ULTIMATE LEVEL)

	Cases **A** & **B**	Case **C** Max.	Case **C** Avg.	*NOTE: Cases A, B, and C shall be considered*	
p =	19.0 psf	24.87 psf	20.31 psf	$p = q_h G C_f$	
F =	1689 lbs	1804 lbs	1804 lbs	$F = q_h G C_f A_s$	(Equation 29.3-1)

F_{max} =	**1804**	lbs	maximum total lateral force at supported edge
M_{max} =	**16159**	lb-ft	maximum total moment at supported side
T_{max} =	**0**	lb-ft	no torsion for side support condition, see moment above

VLMK ENGINEERING + DESIGN | Project: ODOC HVAC | Job #: 20210146 | By: RJK | Date: July 2021 | Sheet #:

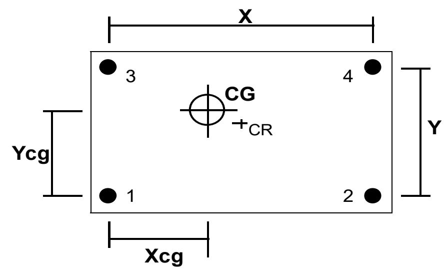
Mechanical Unit Anchorage Design

Based on the 2018 International Building Code and ASCE 7-16

DESIGN INPUT

Seismic Parameters:

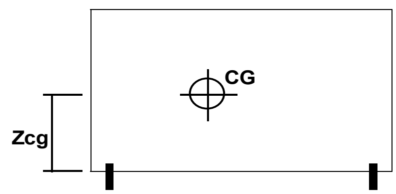
S_{DS} =	0.630	g	Design Spectral Response Acceleration
Ω =	2.0		Overstrength Factor [ASCE Table 13.5-1 or 13.6-1]
a_p =	2.5		[ASCE Table 13.5-1 or 13.6-1]
R_p =	6.0		[ASCE Table 13.5-1 or 13.6-1]
I_p =	1.00		[ASCE 13.1.3]
z =	1	ft	Attachment height from base of structure
h =	1	ft	Average roof height of structure from base



PLAN VIEW

Wind Parameters:

$P_{HORIZ.}$ =	24.9	psf	Design Wind Pressure (psf), 1.0W
P_{UPLIFT} =	16.0	psf	Design Wind Pressure (psf), 1.0W



SIDE VIEW

Mechanical Unit Parameters:

W_p =	4,550	lbs	Total Weight
X =	164.0	in	Base Dimension (max)
Y =	69.0	in	Base Dimension (min)
Z =	78.0	in	Height of Unit
Z_{curb} =	14.0	in	Height of Curb, where occurs
X_{cg} =	76.0	in	Center of Gravity
Y_{cg} =	46.6	in	Center of Gravity
Z_{cg} =	39.0	in	Center of Gravity (excluding curb)

Load Combinations:

Seismic:	Wind:
$(0.9-0.2S_{DS})D + \Omega E$	0.9D + 1.0W
$(0.6-0.14S_{DS})D + 0.7E$	0.6D + 0.6W

ANALYSIS

Base Shear: (Load applied to all (4) anchors/corners together)

Seismic:

$$F_p = \frac{0.4 a_p S_{DS} W_p}{R_p / I_p}\left(1 + 2\frac{z}{h}\right) = \quad 1433 \text{ lbs}$$

$\leq 1.6 S_{DS} I_p W_p$ = 4586 lbs *OK*

$\geq 0.3 S_{DS} I_p W_p$ = 860 lbs *OK*

Base Shear, ΩV_{uE} = 2867 lbs Seismic, ΩE

Wind: V_{uW} = 2609 lbs Wind, 1.0W

$V_{u,\ BASE}$ = 2867 lbs Seismic, ΩE

= 1565 lbs (ASD, 0.6W)

Anchor Shear: (Load applied to each anchor/corner)

Seismic:

Anchor:	dx	dx^2	dy	dy^2
1	76	5776	46.6	2171.6
2	88	7744	46.6	2171.6
3	76	5776	22.4	501.76
4	88	7744	22.4	501.76
		27040		5346.64

Design Eccentricity = 5%

e_x =	14.2	in	e_y =	15.55	in
M_{x-x} =	40704	in-lbs	M_{y-y} =	44574	in-lbs
Y-Direction			X-Direction		
$V_{1,3}$ =	831	lbs	$V_{1,2}$ =	1105	lbs
$V_{2,4}$ =	849	lbs	$V_{3,4}$ =	903	lbs

Wind: $V_{1,2,3,4}$ = 652 lbs

Max $V_{u,\ ANCHOR}$ = 1105 lbs Seismic, ΩE

= 391 lbs (ASD, 0.6W)

Overturning/Uplift: (Load applied to each anchor/corner)

Seismic:	M_{ot} =	75962	lb-in	Seismic, ΩE
	$M_{res,x}$ =	267649	lb-in	Seismic, ΩE
	$M_{res,y}$ =	78886	lb-in	Seismic, ΩE
Wind:	M_{ot} =	120012	lb-in	Wind, 1.0W
	$M_{res,x}$ =	311220	lb-in	Wind, 1.0W
	$M_{res,y}$ =	91728	lb-in	Wind, 1.0W

Net Tension: T_x* = -269 lbs Wind, 1.0W

T_y* = 519 lbs Wind, 1.0W

Max $T_{u,\ ANCHOR}$* = 519 lbs Wind, 1.0W

= 267 lbs (ASD, 0.6W)

*Negative (-) values indicate there is no net uplift

LNA Box Bolts

Loads:

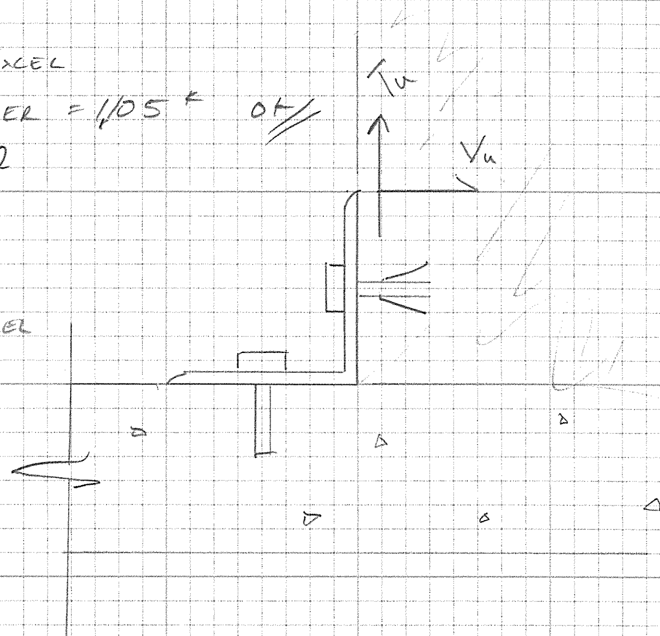
V_u / CORNER = 1105 lbs
T_u / CORNER = 519 lbs
} SEE C-4

Analysis:

TENSION IN LNA BOLT = SHEAR FROM EXCEL

(2) BOLTS (2.96^K) = 5.92^K ≥ V_u/CORNER = 1.105^K OK//

↑ FROM ESR 3217, TABLE 2 @ BQ1GAL12C



SHEAR IN LNA BOLT = TENSION FROM EXCEL

(2) BOLTS (4.32^K) = 8.64^K ≥ T_u/CORNER = 0.519^K

OK//

↑ FROM ESR 3217, TABLE 2 @ BQ1GAL12C

INTERACTION: $\left(\frac{T_u}{T_a}\right)^2 + \left(\frac{V_u}{V_a}\right)^2 < 1.0$

$\left(\frac{1.105^k}{5.92^k}\right)^2 + \left(\frac{0.519^k}{8.64^k}\right)^2 = 0.03 + 0.004$

$0.04 < 1.0$ OK//

Results:

SECURE HVAC TO ANGLE USING (2) 1/2" DIA LNA BOX BOLTS SIZE 1

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.1

Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	1/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description: 20210146
Anchorage of angles to restrain HVAC on pad
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Stainless Steel
Diameter (inch): 0.500
Nominal Embedment depth (inch): 3.250
Effective Embedment depth, h_{ef} (inch): 1.860
Code report: IAPMO UES ER-493
Anchor category: 1
Anchor ductility: Yes
h_{min} (inch): 5.00
c_{ac} (inch): 6.00
C_{min} (inch): 2.25
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 8.00
State: Cracked
Compressive strength, f'c (psi): 3500
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 3.00 x 6.00 x 0.25

Recommended Anchor
Anchor Name: Titen HD® Stainless Steel - 1/2"Ø SS Titen HD, hnom:3.25" (83mm)
Code Report: IAPMO UES ER-493

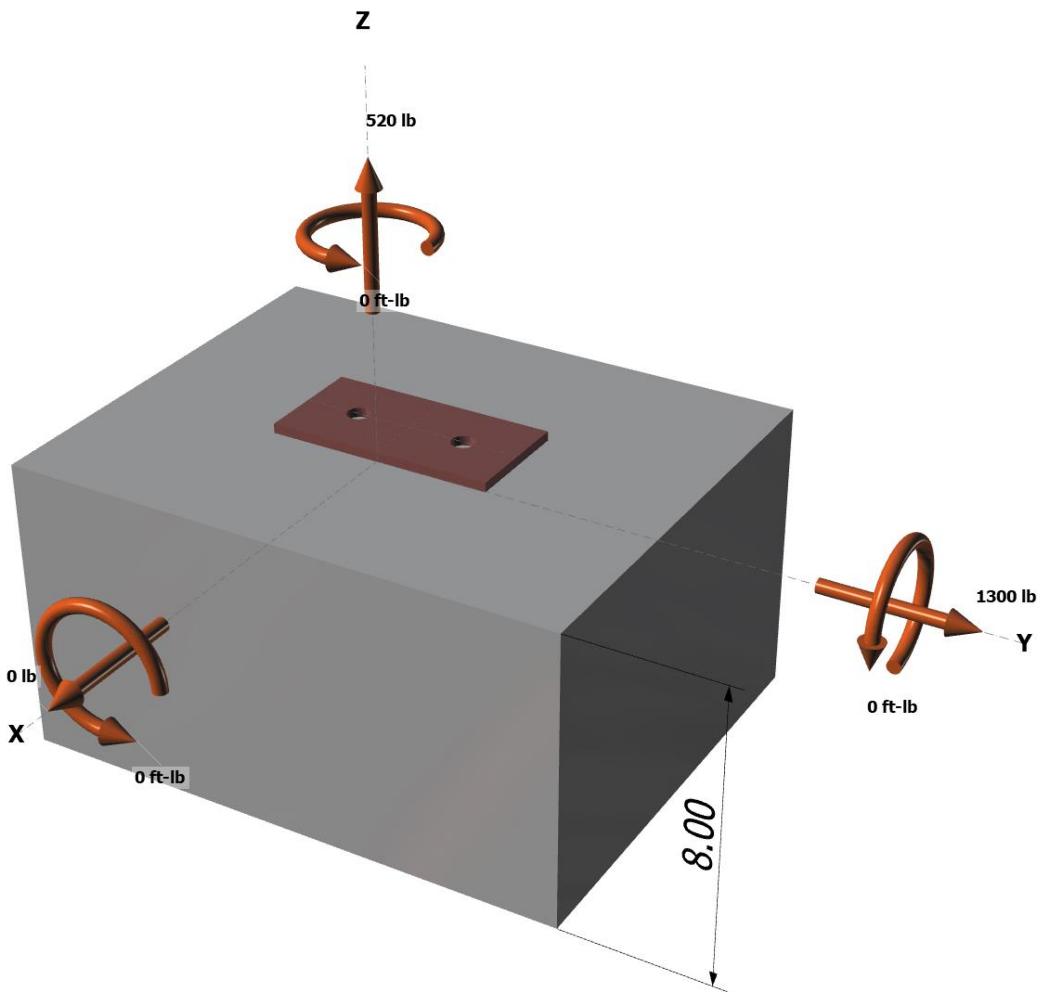
Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	2/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Strength level loads:

N_{ua} [lb]: 520
V_{uax} [lb]: 0
V_{uay} [lb]: 1300
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

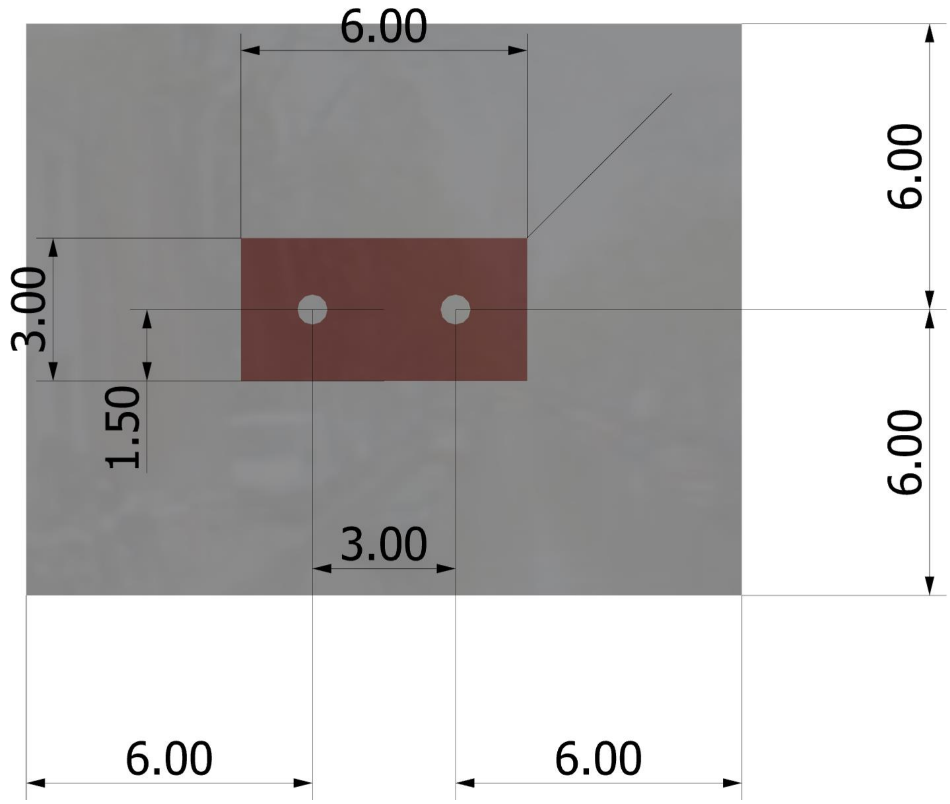
<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.1

Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	3/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
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Version 2.9.7376.1

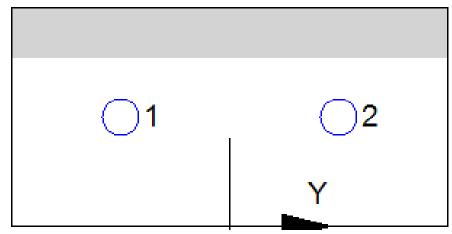
Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	4/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	564.1	650.0	650.0	919.2
2	564.1	-650.0	650.0	919.2
Sum	1128.2	0.0	1300.0	1838.5

Maximum concrete compression strain (‰): 0.07
Maximum concrete compression stress (psi): 298
Resultant tension force (lb): 1128
Resultant compression force (lb): 608
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
20885	0.75	15664

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3500	1.860	2551

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc}/A_{Nco})\,\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
47.88	31.14	6.00	1.000	1.000	1.00	1.000	2551	0.65	1912

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}\lambda_a N_p(f'_c/2{,}500)^n$ (Sec. 17.3.1, Eq. 17.4.3.1 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	1.00	1995	3500	0.50	0.65	1151

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
5345	1.0	0.65	3474

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
1.86	0.500	1.00	3500	6.00	5597

$\phi V_{cbgx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
120.00	162.00	1.000	0.900	1.000	1.061	5597	0.70	2770

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
1.86	0.500	1.00	3500	5.33	4691

$\phi V_{cby} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
96.00	128.00	0.925	1.000	1.000	4691	0.70	2278

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
1.86	0.500	1.00	3500	5.33	4691

$\phi V_{cbx} = \phi\,(2)(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
96.00	128.00	1.000	1.000	1.000	4691	0.70	4925

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
1.86	0.500	1.00	3500	5.33	4691

$\phi V_{cbgy} = \phi\,(2)(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
120.00	128.00	1.000	1.000	1.000	1.000	4691	0.70	6156

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi k_{cp}N_{cb} = \phi k_{cp}(A_{Nc}/A_{Nco})\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

k_{cp}	A_{Nc} (in²)	A_{Nco} (in²)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cp} (lb)
1.0	23.94	31.14	1.000	1.000	1.000	2551	0.70	1373

11. Results

Interaction of Tensile and Shear Forces (Sec. R17.6)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	564	15664	0.04	Pass
Concrete breakout	**1128**	**1912**	**0.59**	**Pass (Governs)**
Pullout	564	1151	0.49	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	919	3474	0.26	Pass
T Concrete breakout x-	650	2770	0.23	Pass
T Concrete breakout y+	1300	2278	0.57	Pass
|| Concrete breakout y-	650	4925	0.13	Pass
|| Concrete breakout x-	1300	6156	0.21	Pass
Concrete breakout, combined	-	-	0.62	Pass
Pryout	**919**	**1373**	**0.67**	**Pass (Governs)**

Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.41	0.51	92.7%	1.0	Pass

1/2"Ø SS Titen HD, hnom:3.25" (83mm) meets the selected design criteria.

12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.1

Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	1/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description: 20210146
Anchorage of angles to restrain HVAC on pad
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Stainless Steel
Diameter (inch): 0.500
Nominal Embedment depth (inch): 3.250
Effective Embedment depth, h_{ef} (inch): 1.860
Code report: IAPMO UES ER-493
Anchor category: 1
Anchor ductility: Yes
h_{min} (inch): 5.00
c_{ac} (inch): 6.00
C_{min} (inch): 2.25
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 8.00
State: Cracked
Compressive strength, f'_c (psi): 3500
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 3.00 x 6.00 x 0.25

Recommended Anchor
Anchor Name: Titen HD® Stainless Steel - 1/2"Ø SS Titen HD, hnom:3.25" (83mm)
Code Report: IAPMO UES ER-493

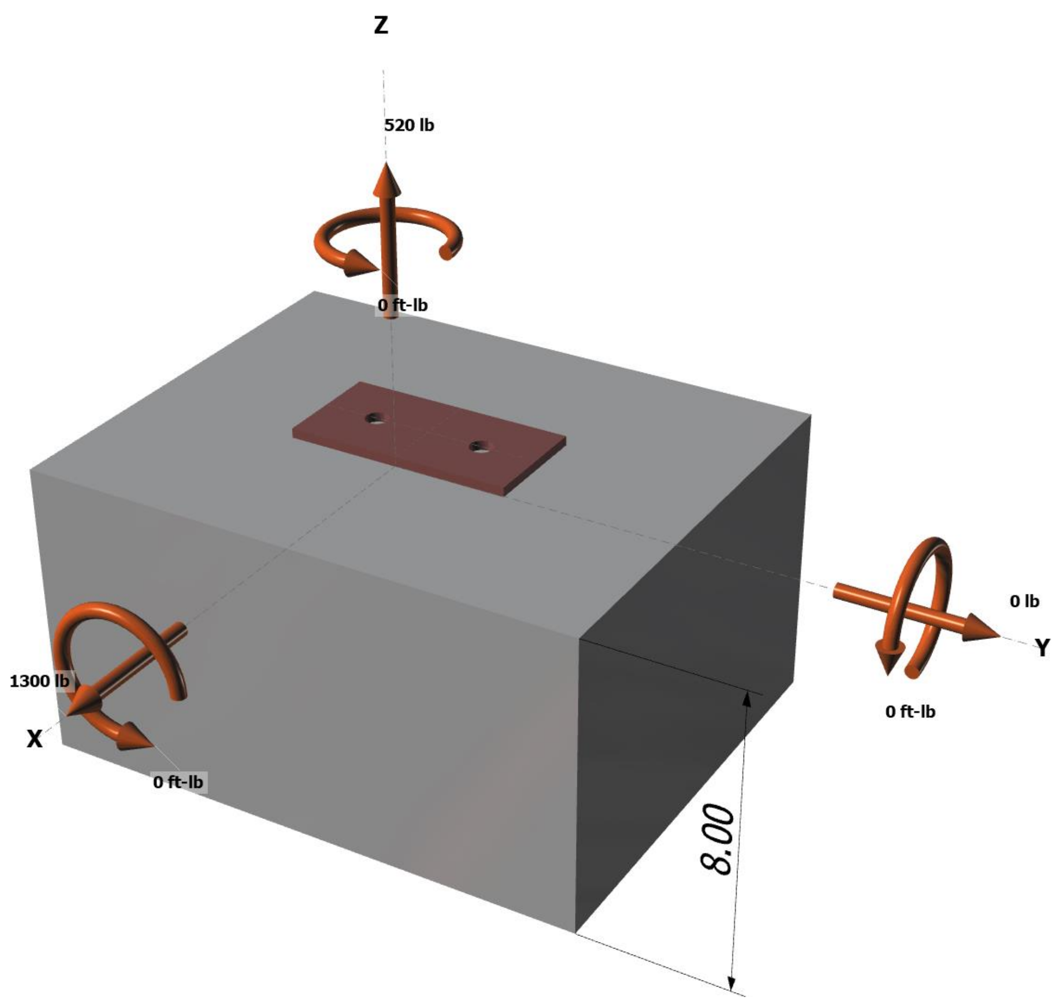
Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	2/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Strength level loads:

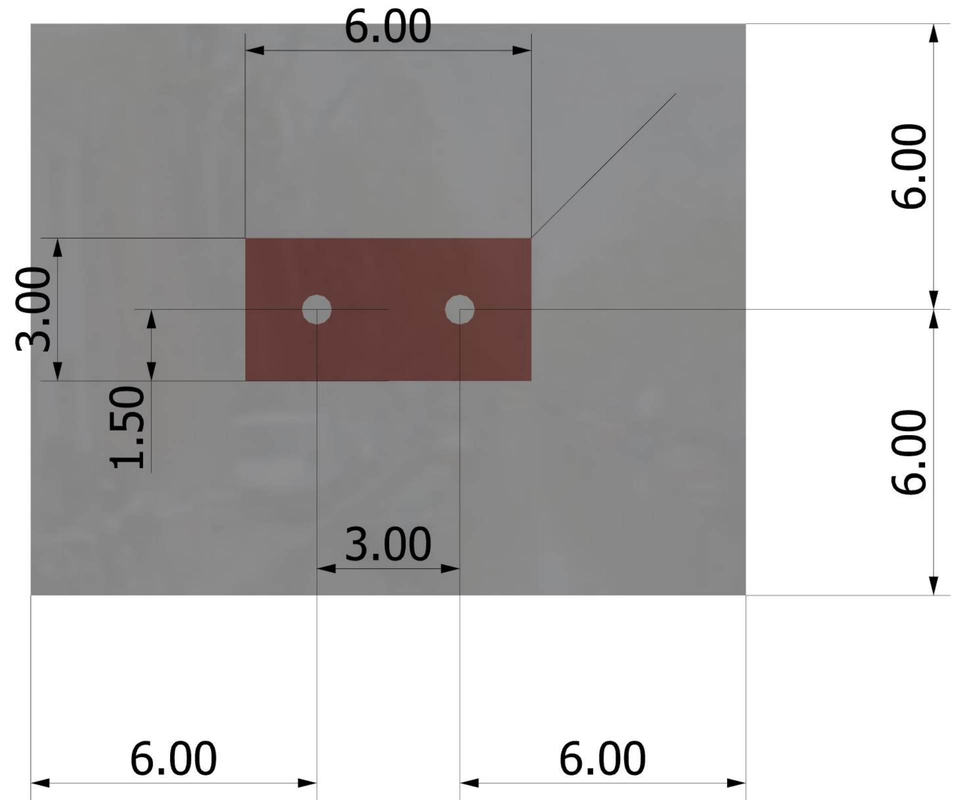
N_{ua} [lb]: 520
V_{uax} [lb]: 1300
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	3/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

<Figure 2>

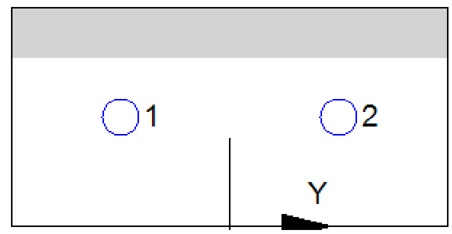


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	564.1	650.0	0.0	650.0
2	564.1	650.0	0.0	650.0
Sum	1128.2	1300.0	0.0	1300.0

Maximum concrete compression strain (‰): 0.07
Maximum concrete compression stress (psi): 298
Resultant tension force (lb): 1128
Resultant compression force (lb): 608
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
20885	0.75	15664

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3500	1.860	2551

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
47.88	31.14	6.00	1.000	1.000	1.00	1.000	2551	0.65	1912

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi \Psi_{c,P} \lambda_a N_p (f'_c / 2{,}500)^n$ (Sec. 17.3.1, Eq. 17.4.3.1 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	1.00	1995	3500	0.50	0.65	1151

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
5345	1.0	0.65	3474

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
1.86	0.500	1.00	3500	5.33	4691

$\phi V_{cbgx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
120.00	128.00	1.000	0.925	1.000	1.000	4691	0.70	2847

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
1.86	0.500	1.00	3500	5.33	4691

$\phi V_{cbx} = \phi\,(2)(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
96.00	128.00	1.000	1.000	1.000	4691	0.70	4925

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi k_{cp}N_{cbg} = \phi k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cpg} (lb)
1.0	47.88	31.14	1.000	1.000	1.000	1.000	2551	0.70	2746

11. Results

Interaction of Tensile and Shear Forces (Sec. R17.6)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	564	15664	0.04	Pass
Concrete breakout	**1128**	**1912**	**0.59**	**Pass (Governs)**
Pullout	564	1151	0.49	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	650	3474	0.19	Pass
T Concrete breakout x+	1300	2847	0.46	Pass
|| Concrete breakout y-	650	4925	0.13	Pass
Pryout	**1300**	**2746**	**0.47**	**Pass (Governs)**

Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.41	0.29	70.3%	1.0	Pass

1/2"Ø SS Titen HD, hnom:3.25" (83mm) meets the selected design criteria.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.1

Company:	VLMK	Date:	7/8/2021
Engineer:	Ryan Kelly	Page:	6/6
Project:	ODOC HVAC		
Address:			
Phone:			
E-mail:			

12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

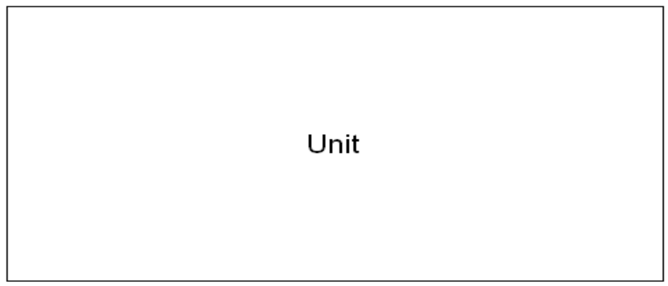
- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Unit Corner Weights

1,586 lb | 1,370 lb

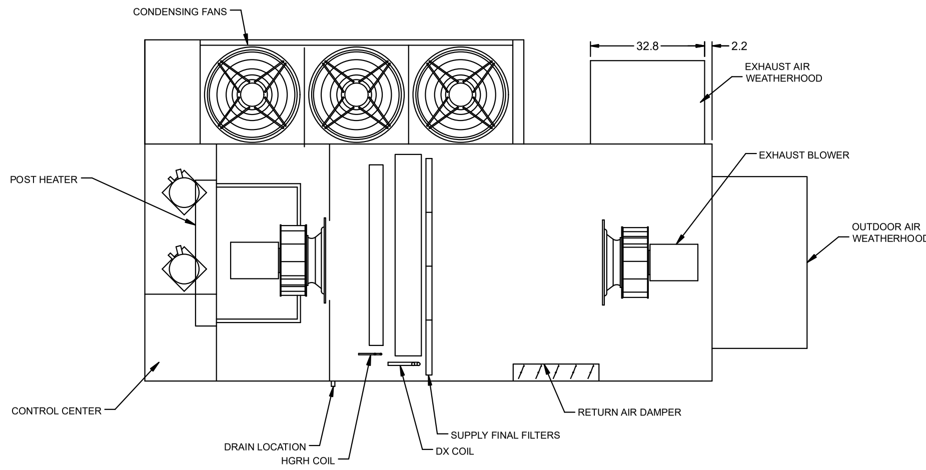


754 lb | 652 lb

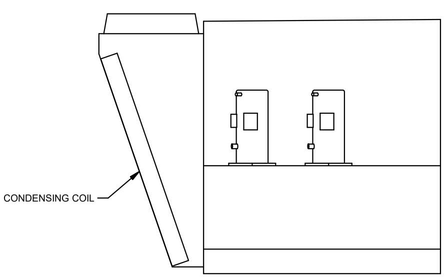
Note

Estimated corner weights are shown looking down on unit and the outside air intake will be on the right. Weights are applied at the base of the unit. Images not drawn to scale.

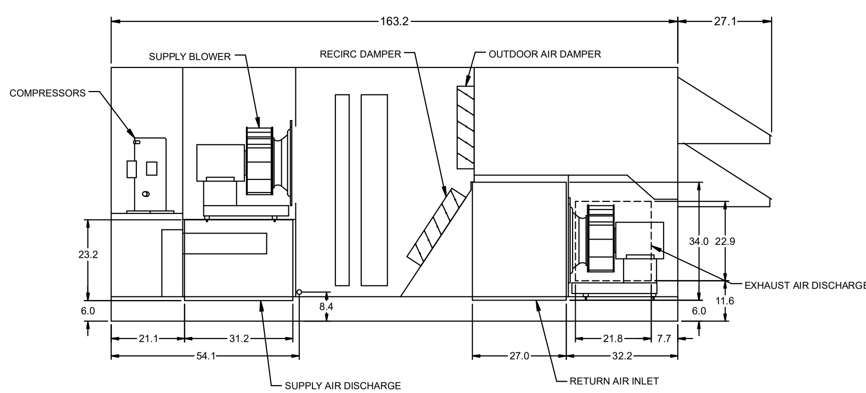
Overview Drawings



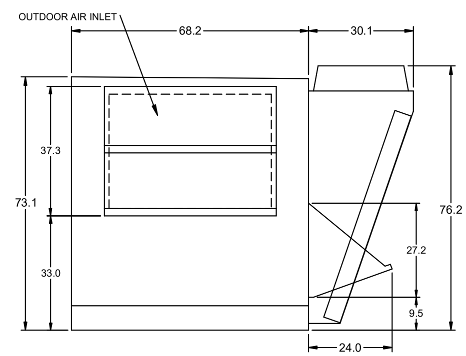
Plan



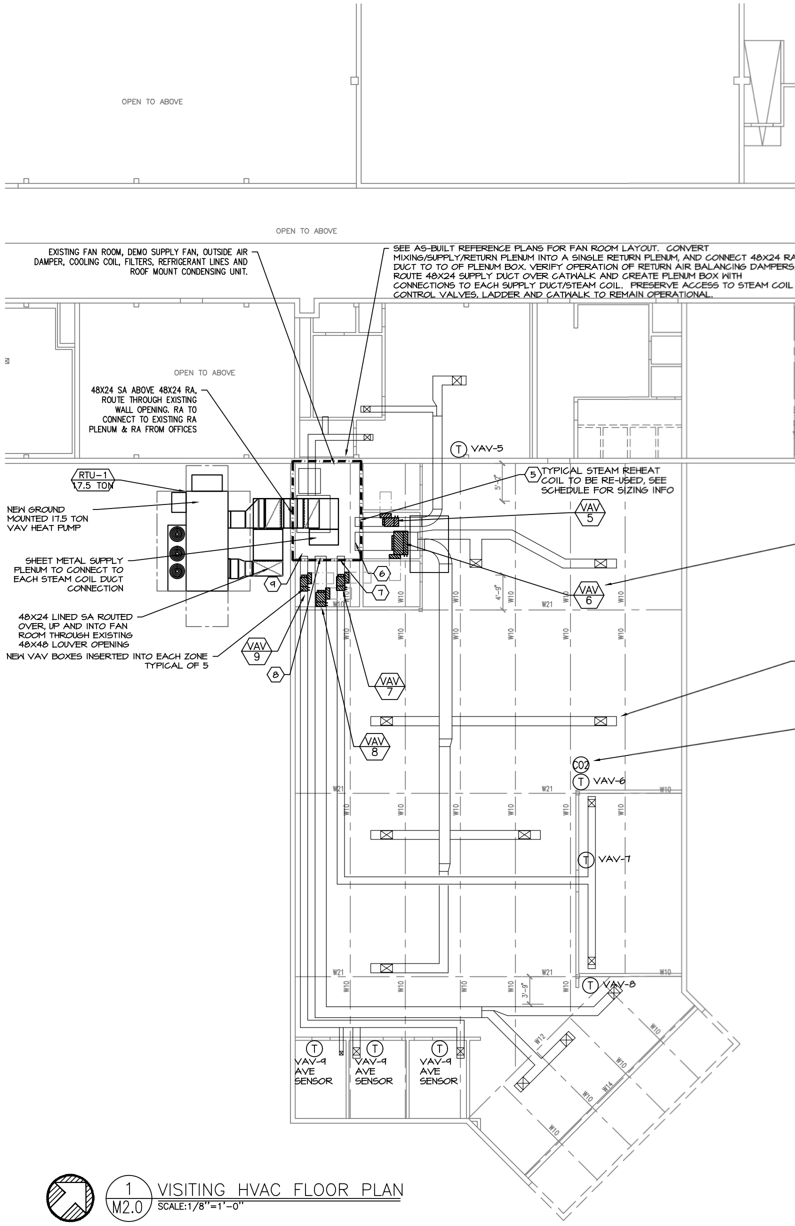
Left End



Elevation



Right End



1 M2.0 VISITING HVAC FLOOR PLAN
SCALE:1/8"=1'-0"

INSERT VAV BOXES INTO STRAIGHT RUNS OF DUCTWORK, WHILE TRYING TO KEEP AS CLOSE TO MANUFACTURES SUGGESTIONS FOR STRAIGHT DUCT RUN PRIOR TO VAV FLOW SENSOR. VAV BOXES MAY BE SHIFTED DOWN STREAM AS NEEDED BASED ON FIELD CONDITIONS. VAV-6 MAY BE SPLIT INTO TWO SMALLER BOXES VAV 6A 6B IF EASIER TO INSTALL, IF THIS OPTION IS USED, OPERATE BOTH BOXES OF SAME T STAT

BALANCE ALL DIFFUSERS SUPPLY AND FLOOR RETURN TO CFMS LISTED ON AS-BUILT REFERENCE DRAWINGS + 15% BALANCE TOTAL RTU FLOW AT FULL COOLING TO 7200 CFM

SPACE MOUNT CO2 SENSOR FOR OUTSIDE AIR CONTROL

STEAM REHEAT COILS

TYPICAL OF ALL REHEAT COILS:
MIN 1 ROW, MAX 8 FPI, EAT 68°F
2 PSI @ COIL, 3 PSI MAX DROP IN VALVE

		CFM	SIZE	MBH	FV	VALVE	TRAP
5	EXISTING OFFICES	625	12"x15"	15	500	15	23
6	VISITORS ROOM	3500	24"x42	75	500	75	113
7	CHILDRENS ROOM	450	9"x12"	12	450	12	18
8	WAITING ROOM	1200	15"x24"	48	480	48	72
9	INTERVIEW ROOM	475	9"x12"	16	475	16	24
10	SPACE EXHAUST FAN PACE CRE20F WITH SOUND CURB 5000 CFM SET FOR 394 RPM (1)						

2 M2.0 EXISTING RE-HEAT STEAM COILS
SCALE:1/8"=1'-0"

5 6 7 8 9

REPLACE STEAM CONTROL VALVES AND ACTUATORS (TYPICAL OF 5) FOR EACH STEAM COIL. VERIFY/REFURBISH CONDENSATE TRAPS/TRAP OPERATION. CONNECT NEW DDC CONTROLS TO EXISTING STEAM CONTROL VALVES. NOTE - STEAM VALVES ARE ACCESSED FROM CAT WALK IN FAN ROOM.

PACKAGED HEAT PUMP

	MARK NUMBER	RTU-1 7.5 TON *
	SYSTEM	VISITING
	NOMINAL SIZE - TONS	17.5 TONS
	TYPE	VAV HORIZONTAL DISCHARGE
SUPPLY FAN	TYPE/SIZE	PLENUM-DIRECT DRIVE
SUPPLY FAN	TOTAL SA CFM	7200
SUPPLY FAN	MIN. CFM	1500
SUPPLY FAN	OSA MIN/MAX (CO2 CONTROL)****	500/2000
SUPPLY FAN	ECONOMIZER	DUAL ENTHALPY
SUPPLY FAN	FAN Φ/MOTOR HP	8.81 / 10
SUPPLY FAN	EXTERNAL SP. ("H20)	1.5"
SUPPLY FAN	VARIABLE SPEED SA FAN	YES
EXHAUST FAN	TOTAL EXHAUST CFM	7200
EXHAUST FAN	MIN. CFM	0
EXHAUST FAN	FAN BHP/MOTOR HP	3.16 / 7.5
EXHAUST FAN	EXTERNAL SP. ("H20)	0.75
EXHAUST FAN	VARIABLE SPEED EXH FAN	YES-BUILDING PRESSURE
	FILTER SIZE	TO FIT UNIT
	FILTER TYPE - EXHAUST	NA
	FILTER TYPE - SUPPLY	2"- MERV 13 MIN
HEATING	GAS INPUT (MBH)	NONE
HEATING	EFF.	NA
HEATING	MODULATING	NA
HEAT PUMP-HEAT-COOL	TOTAL CLG. (TONS)	17.5
HEAT PUMP-HEAT-COOL	SENSIBLE CLG. (MBH)	172.8
HEAT PUMP-HEAT-COOL	ENT. EVAP AIR TEMP (DB/WB)	84/67
HEAT PUMP-HEAT-COOL	LVG. EVAP AIR TEMP (DB/WB)	55.0/53.1
HEAT PUMP-HEAT-COOL	AMBIENT AIR (°F)	95
HEAT PUMP-HEAT-COOL	COOLING SEER/EER	5 ISMRE
HEAT PUMP-HEAT-COOL	REFRIGERANT	410A
HEAT PUMP-HEAT-COOL	COMPRESSOR	INVERTOR-SCROLL
HEAT PUMP-HEAT-COOL	HP HEATING. (MBH @ 47°F)	151.5
HEAT PUMP-HEAT-COOL	ENT. EVAP AIR TEMP (DB)	23.5
HEAT PUMP-HEAT-COOL	LVG. EVAP AIR TEMP (DB)	
HEAT PUMP-HEAT-COOL	AMBIENT AIR (°F)	20
HEAT PUMP-HEAT-COOL	HEATING COP (47°/17°F)	
	SECONDARY HEAT +	41.0 KW SCR
	DESIGN WEIGHT (LBS.)	4550 LBS
	SMOKE DETECTOR (RETURN DUCT)	YES
	PAD MOUNT - HORIZONTAL DISCHARGE	YES
	BASIS OF DESIGN - VALENT **	VX-212-17.5A
	ELECTRICAL (VOLTS/PHASE)	208/3
	ELECTRICAL (MCA/MOCP)	284.8/300
	BACNET DDC INTERFACE ***	YES
	SHORT CIRCUIT RATING	5 KAIC
	UV LIGHTS	YES
	BIPOLAR IONIZATION	YES
	ECONOMIZER FAULT DETECTION	YES
	FACTORY WIRED DISCONNECT	YES
	FACTORY SERVICE OUTLET	YES
	MOTOR SHAFT GROUNDING	YES

* - PACKAGED VAV HEAT PUMP UNIT - GROUND MOUNTED WITH HORIZONTAL DISCHARGE AND RETURN.
** - BASIS OF DESIGN IS VALENT EQUAL DAIKIN, YORK, TRANE OR CARRIER MAY BE USED, VE ITEMS TO BE PRESENTED TO OWNER PRIOR TO BID.
*** - PROVIDE UNIT WITH BACNET INTERFACE TO INTERCONECT WITH EXISTING DELTA DDC CONTROLS.
**** - OUTSIDE AIR TO VARY BETWEEN MIN AND MAX CFM BASED ON SPACE CO2 LEVELS.
+ SECONDARY ELECT HEAT FOR UNIT FREEZE PROTECTION/BACK UP HEAT ONLY
- -DDC CONTROLS TO OPERATE STEAM REHEAT COILS AS PRIMARY HEATING SOURCE WHEN HEAT PUMP IS NOT OPERATING.

VAV BOXES

MARK NO.	TYPE	MAX COOLING CFM	20% OF COOLING CFM	MIN VENTILATION CFM	MIN 300 CFM	MAXIMUM DEADBAND CFM	MAXIMUM HEATING CFM 50% or VENT	INLET IN.	OUTLET IN.	MAX. STATIC LOSS *	CONTROL TYPE
VAV-5	VAV	718.75	144	50	0	144	359	10	14X13	0.05	DDC
VAV-6	VAV	4025	805	300	0	805	2013	24X16	24X18	0.05	DDC
VAV-7	VAV	517.5	104	40	0	104	259	8	12X10	0.05	DDC
VAV-8	VAV	1380	276	50	0	276	690	12	16X15	0.05	DDC
VAV-9	VAV	546.25	109	60	0	109	273	8	12X10	0.05	DDC
	TOTAL	7187.5	***	500		1438	3594				

* - VAV BOX ONLY - MAX PRESSURE DROP
** - THIRD OCTAVE CERTIFIED RATING IN ACCORDANCE WITH ARI STANDARD 880-94
*** - SET AIR FLOWS FOR EACH ZONE TO BE 115% OF ORIGINAL DESIGN CFMS

7-6-21
REGISTERED PROFESSIONAL ENGINEER 54,607 OREGON JULY 11, 2000 MARK R. DENTER
EXPIRES: 31DEC21

Date: 7-13-20
Proj No: 10039
Drawn By: MD
Chkd By: MD
DSGN By: MD
Acad File0039-M10

OREGON STATE CORRECTIONAL INSTITUTION
OSCI CONTROLS UPGRADES
OREGON DEPT OF CORRECTIONS
SALEM OREGON

FLOOR PLANS

MEIA INC.

Consulting Engineers
2007 S.E. Ash St.
Portland, OR 97214
(503) 234-0548

SHEET
M2.0
2 OF 3

R - 3