HGA

1200 R St, Suite 100
Sacramento, CA 95811
(916) 787-5100 fax (916) 784-7738

4610 X STREET
SACRAMENTO, CA 95817

UC Davis
MIND #26 BUILDING IT NETWORK MODERNIZATION
Structural Calculation

REGISTERED PROFESSIONAL ENGINEER
KEVIN R. LOGSDON
S7123
STRUCTURAL
STATE OF CALIFORNIA

UC DAVIS HEALTH BUILDING DEPARTMENT
APPROVED

REVIEWED FOR CODE COMPLIANCE
The set of plans and specifications must be kept on the job site at all times and it is unlawful to make any changes or alterations to the approved set without written permission from the Building Department.
The approval of this plan and specifications SHALL NOT be held to permit or approve the violation of any University Policy or State Building Code.

BY: Paul R. Menard AIA CBO DATE: 04/16/2024

PROJECT #: B24-0061

UC Davis Health
Sacramento, CA 95817

This approval includes 27 pages.

UC DAVIS HEALTH

Facilities Design & Construction
4800 2nd Avenue Suite 3010
Sacramento, California 95817
(916)734-7024

Commission No: 1500-164-00

Date: January 2024
March 2024 - Backcheck #1 B1

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

William Gilliland
for
UCDH Lead DCFM

Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

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OMITTED

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

UC Davis Health

2825 50th St, Sacramento, CA 95817, USA

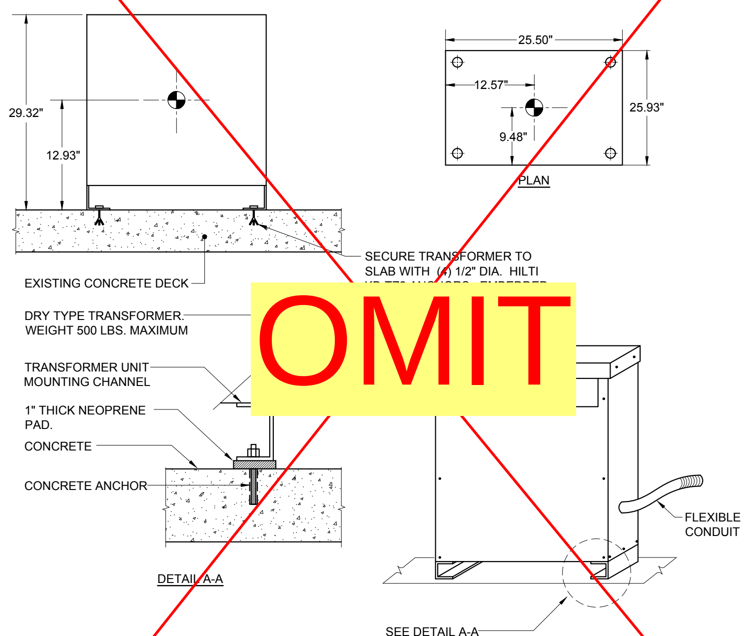
Latitude, Longitude: 38.5497629, -121.4461043

Date	8/14/2023, 9:26:12 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	0.544	MCE_R ground motion. (for 0.2 second period)
S_1	0.247	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.743	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.495	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.365	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.228	MCE_G peak ground acceleration
F_{PGA}	1.372	Site amplification factor at PGA
PGA_M	0.313	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	0.544	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.571	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.247	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.261	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)

Detail 1/E7.01
Dry Type Transformer



1 DRY TYPE TRANSFORMER MOUNTING DETAIL
NO SCALE

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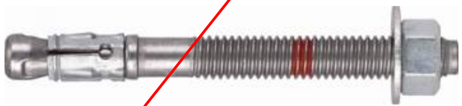
Specifier's comments:

1 Input data



Anchor type and diameter:	**Kwik Bolt TZ2 - CS 1/2 (2) hnom2**
Item number:	2210254 KB-TZ2 1/2x3 3/4
Effective embedment depth:	$h_{ef,act}$ = 2.000 in., h_{nom} = 2.500 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-4266
Issued I Valid:	12/17/2021 | 12/1/2023
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 4.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: ye
	Shear load: yes (

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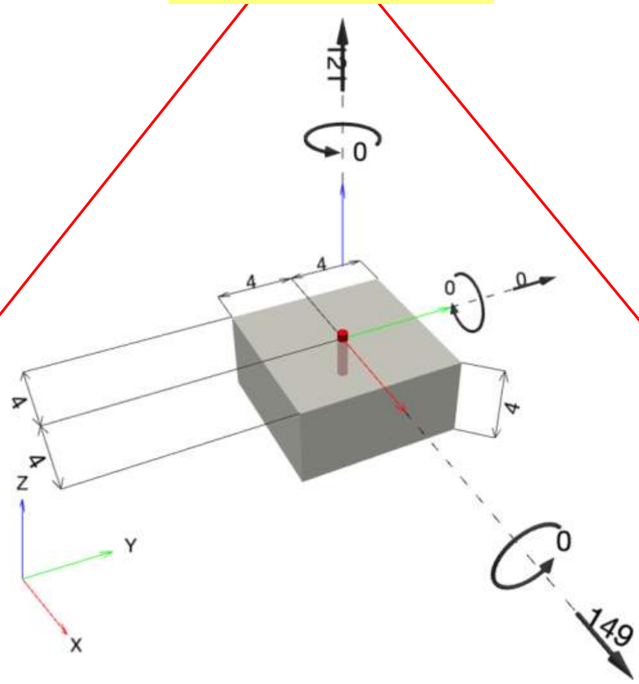
Geometry [in.] & Loading [lb, in.lb]



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1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 121; V_x = 149; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	15

2 Load case/Resulting anchor forces

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	121	149	149	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

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3 Tension load

	Load $_{ua}$	**$_n$ [lb]**	**Utilization $\beta_N = N_{ua}/\phi\ N_n$**	**Status**
Steel Strength*	121	8,433	2	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	121	1,448	9	OK

* highest loaded anchor **anchor group (anchors in tension)

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3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4266

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.10	114,004

Calculations

N_{sa} [lb]
11,244

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
11,244	0.750	1.000	8,433	121

3.2 Concrete Breakout Failure

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ ACI 318-19 Eq. (17.6.2.1a)

$\phi\ N_{cb} \geq N_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(

$A_{Nc0} = 9\ h_{ef}^2$ .4)

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$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ .1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.000	4.000	1.000	5.500	21	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
36.00	36.00	1.000	1.000	2,970

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
2,970	0.650	0.750	1.000	1,448	121

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4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	149	3,599	5	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	149	2,079	8	OK
Concrete edge failure in direction x+**	149	995	15	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-4266

ϕ $V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.10	114,004	1.000

Calculations

$V_{sa,eq}$ [lb]
5,537

Results

OMIT

$V_{sa,eq}$ [lb]	ϕ steel	ϕ nonductile	[illegible]	[illegible]b]
5,537	0.650	1.000	3,599	149

4.2 Pryout Strength

$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \; \psi_{c,N} \; \psi_{cp,N} \; N_b \right]$ ACI 318-19 Eq. (17.7.3.1a)

$\phi \; V_{cp} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9 \; h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c \; \lambda_a \; \sqrt{f'_c} \; h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
1	2.000	4.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
5.500	21	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	[illegible]	[illegible] b]
36.00	36.00	1.000	[illegible]	[illegible] 0

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Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \; V_{cp}$ [lb]	V_{ua} [lb]
2,970	0.700	1.000	1.000	2,079	149

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4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1a)

$\phi\ V_{cb} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
2.667	4.000	1.000	4.000	2.000

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.500	2,500	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	[illegible]	[illegible]b]
32.00	32.00	1.000	[illegible]	[illegible]2

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Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
1,422	0.700	1.000	1.000	995	149

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.084	0.150	5/3	6	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Hilti post-installed anchors shall be installed in accordar [illegible] inted Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

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Fastenin[illegible] criteria!

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7 Installation data

Anchor type and diameter: Kwik Bolt TZ2 - CS 1/2 (2) hnom2

Profile: -

Item number: 2210254 KB-TZ2 1/2x3 3/4

Hole diameter in the fixture: -

Maximum installation torque: 602 in.lb

Plate thickness (input): -

Hole diameter in the base material: 0.500 in.

Hole depth in the base material: 2.750 in.

Drilling method: Hammer drilled

Minimum thickness of the base material: 4.000 in.

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Hilti KB-TZ2 stud anchor with 2.5 in embedment, 1/2 (2) hnom2, Carbon steel, installation per ESR-4266

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque controlled cordless impact tool • Torque wrench • Hammer

Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}
1	0.000	0.000	4.000	4.000	4.00

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8 Remarks; Your Cooperation Duties

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- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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3/20/2024 B1

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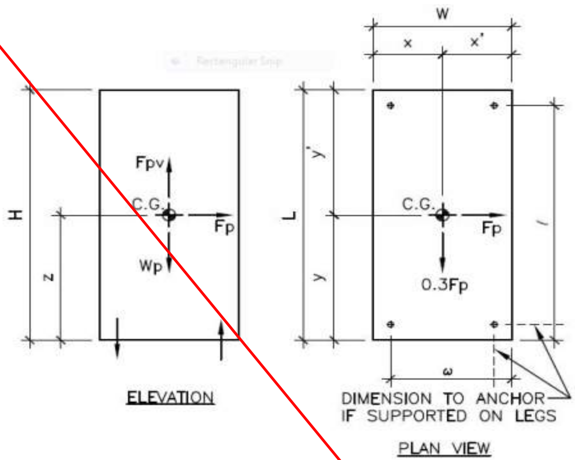
Project :	UCD NetV2 MIND #26 Builing		
Subject:	Dry Type XFMR		
Comm No.:	1500-164-00	Page:	of
Name:	ZL	Date:	Jan 2024

2019 CBC & ASCE 7-16 EQUIP ANCHORAGE FORCES (LRFD) -



Height, H = 30.0 in
Height to center of gravity, z_q = 13.0 in
Width, W = 26.0 in
Overturning Dimension, ω = 20.0 in
# of anchors in tension, $\#_{T,\omega}$ = 2
x = 13.0 in
x' = 13.0 in
Length, L = 26.0 in
Overturning Dimension, ℓ = 20.0 in
# of anchors in tension, $\#_{T,\ell}$ = 2
y = 13.0 in
y' = 13.0 in
Weight, W_p = 500 lbs
# of anchors in shear, $\#_V$ = 4
Height of component with respect to grade, z = 2.00 ft
Average roof height, h = 2.00 ft

Seismic

Seismic design requirements for equipment are based on ASCE 7-16, Chapter 13.

COMPONENT AMPLIFICATION FACTOR
ASCE Section 13.5, 13.6 & ASCE Table 13.5-1, 13.6-1 — a_p = 2.5

COMPONENT RESPONSE MODIFICATION FACTOR
ASCE Section 13.5, 13.6 & ASCE Table 13.5-1, 13.6-1 — R_p = 2.5

DESIGN SPECTRAL RESPONSE ACCELERATION — S_{DS} = 0.495

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COMPONENT IMPORTANCE FACTOR
ASCE Section 13.1.3 — I_p = 1.00

ATTACHMENT FACTOR IN CONCRETE OR MAS
ASCE Tables 13.5-1, 13.6-1 — Ω factor = 2.0

SEISMIC DESIGN FORCE

ASCE Section 13.3.1 & ASCE Equation 13.3-1	$F_p = 0.4{*}a_p{*}S_{DS}{*}W_p/(R_p/I_p)(1+2z/h)$	F_p = 0.594 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-2	$F_{p.max} = 1.6{*}S_{DS}{*}I_p{*}W_p$	$F_{p,max}$ = 0.792 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-3	$F_{p,min} = 0.3{*}S_{DS}{*}I_p{*}W_p$	$F_{p,min}$ = 0.149 Wp

SEISMIC DESIGN FORCES

ASCE Section 13.1.8 & 13.3.1	$F_{p,} = F_{p,govern}$	F_p = 0.594 Wp
ASCE Section 13.1.8 & 13.3.1	$F_{pv} = 0.2{*}S_{DS}{*}W_p$	F_{pv} = 0.099 Wp

DESIGN FORCES

$F_{p,\Omega} = Fp * W_p * \Omega\ factor$ = 594 lbs
$OTM = z_q * F_{p,\Omega}$ = 7722 lb-in
F_{pv} = 50 lbs
$DLRM = (0.9W_p - F_{pv}) * x_{min}$ = 5207 lb-in

$$T = \frac{OTM - DLRM}{\omega * \#_{T,\omega}} + \frac{0.3 * OTM}{\ell * \#_{T,\ell}}$$

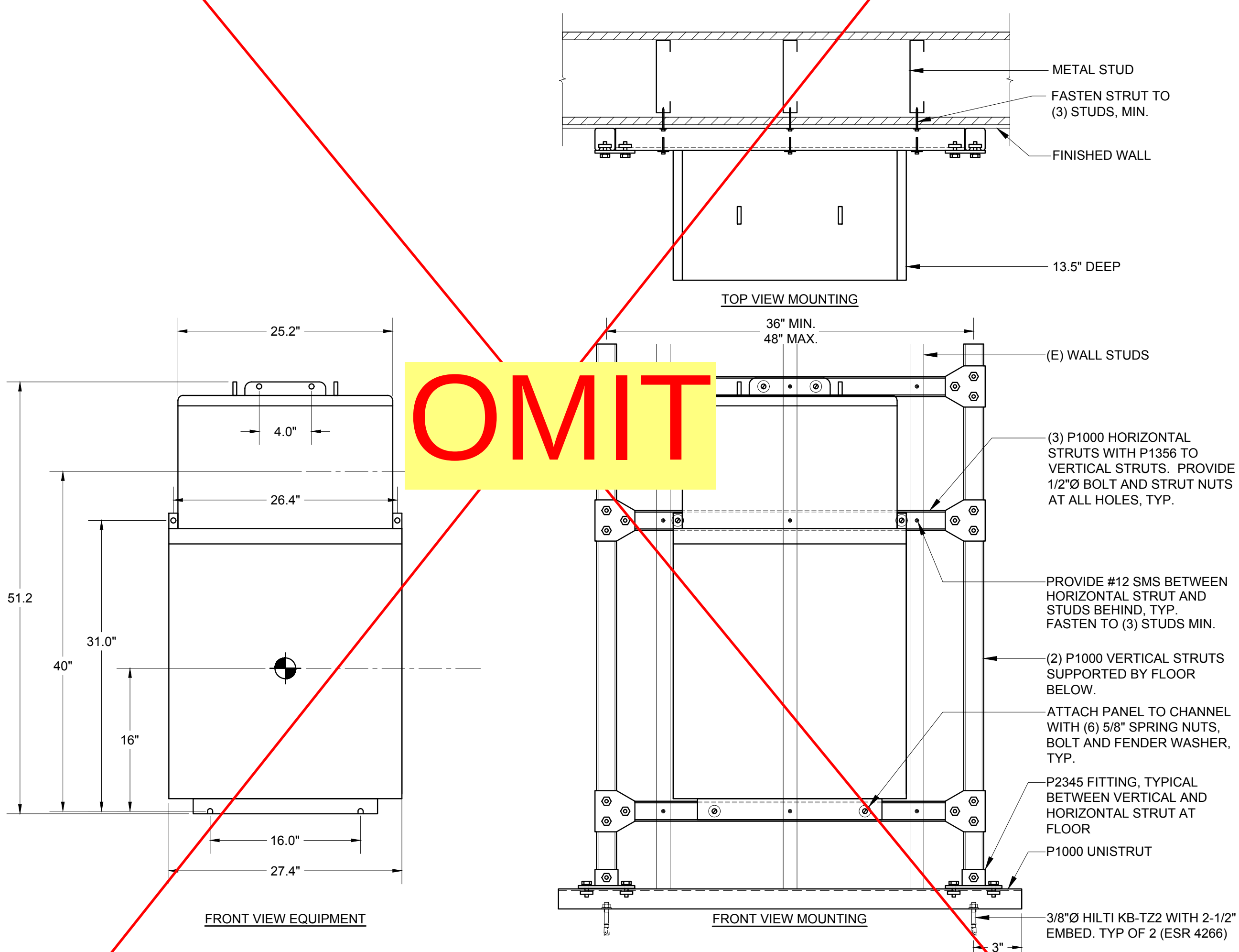
T = 121 lbs

$$V = \frac{F_{p,\Omega} * (2 * y_{max} / L)}{\#_V}$$

V = 149 lbs

Detail 3/E7.01
15kVA Mini Power Zone

OMIT



NOTES:
1. USE FENDER WASHERS ON ALL SCREWS.
2. WEIGHT- 550 LBS. MAXIMUM.
3. ALL SCREWS #12 SELF-TAPPING SHEET METAL SCREWS-TRAXX BY ITW BUILDEX OR APPROVED EQUIVALENT. MIN O.C. SPACING OF SCREWS IS 1" TYPICAL, UNLESS NOTED. MIN EDGE DISTANCE - CL SCREW TO MEMBER EDGE IS 1/2" TYP. UON.

3 **15 KVA MINI POWER ZONE MOUNTING DETAIL.**

NO SCALE

HGA

Project	UCD NetV2 MIND #26 Building		
Subject	15kVA Mini Power Zone		
Comm No.	1500-164-00	Page	1 of 1
Name	ZL	Date	Jan 2024

ASCE 7-16 Seismic Design Requirements for Nonstructural Components

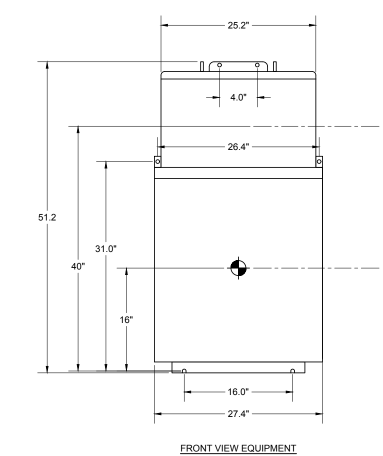
Component Classification: 15kVA Mini Power Zone

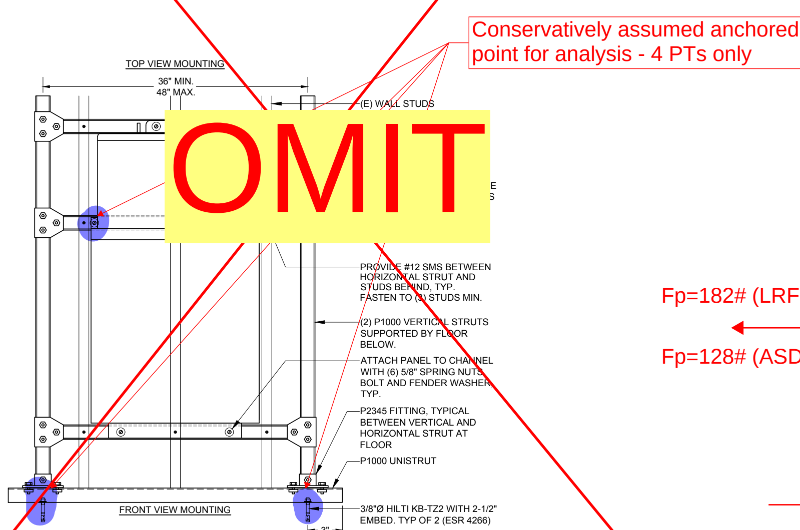
User Inputs		
S_{DS}	0.495	
W_p	550	lbs
a_p	1	
R_p	1.5	
I_p	1	
z	1.5	ft
h	2	ft

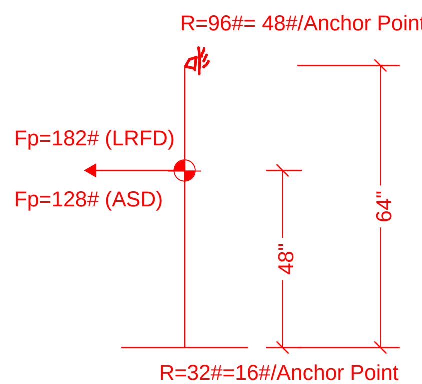
Calculations		
F_p(13.3-1)	181.500	lbs
F_p(13.3-2)	435.600	lbs
F_p(13.3-3)	81.675	lbs

Design Force		
F_p	181.500	lbs

A *vertical* force must be concurrently applied.		
F_{pv} (+)	54.450	lbs
F_{pv} (-)	-54.450	lbs







NOTES:

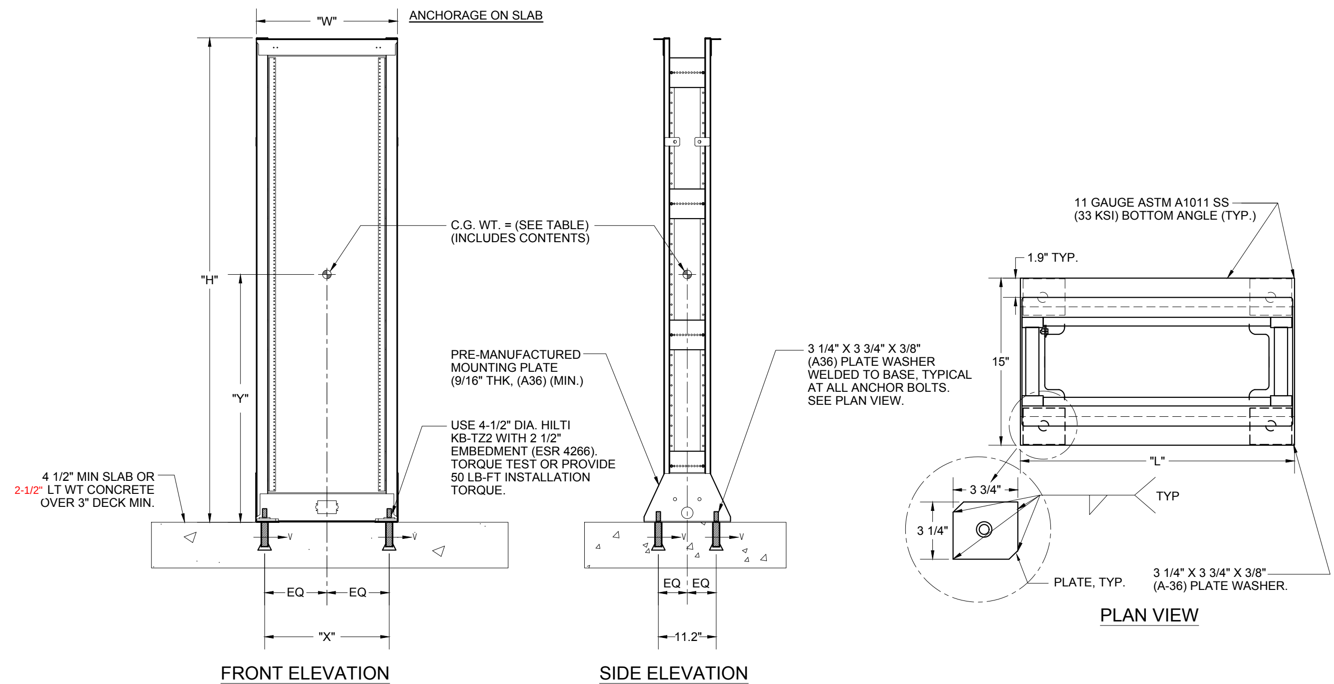
Check SMS Capacity:

Min 20 GA Studs
DCR=48/95=0.51 OK

Expansion Anchor By inspection 3/8" Dia Hilti LB-TZ2 OK due to low loads.

1/E7.05 B1

Detail ~~4/E7.05~~ Equipment Rack Anchorage



UNIT NUMBER	WEIGHT (lbs)	"H" (in)	"Y" (in)	"W" (in)	"X" (in)
SB85219084	714	84	42	24.75	21.62

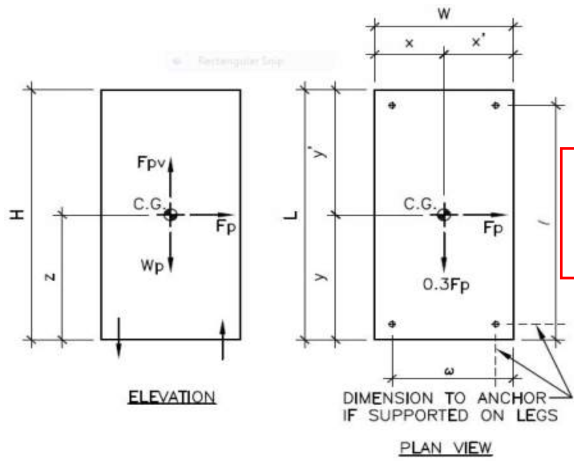
*NOTE: MINIMUM CONCRETE STRENGTH F'C = 3000psi.

1 EQUIPMENT RACK - MOUNTED TO SLAB ON GRADE OR CONCRETE FILLED METAL DECK

NO SCALE

B1

2019 CBC & ASCE 7-16 EQUIP ANCHORAGE FORCES (LRFD) -



Wt< 2000#, Deck ok per minimum design loads

Height, H = 84.0 in
Height to center of gravity, z_q = 42.0 in
Width, W = 11.2 in
Overturning Dimension, ω = 11.2 in
# of anchors in tension, $\#_{T,\omega}$ = 2
x = 5.6 in
x' = 5.6 in
Length, L = 24.8 in
Overturning Dimension, ℓ = 21.6 in
# of anchors in tension, $\#_{T,\ell}$ = 2
y = 12.4 in
y' = 12.4 in
Weight, W_p = 714 lbs
# of anchors in shear, $\#_V$ = 4
Height of component with respect to grade, z = 1.00 ft
Average roof height, h = 2.00 ft

Seismic

Seismic design requirements for equipment are based on ASCE 7-16, Chapter 13.

Level 2 of 2 story building

COMPONENT AMPLIFICATION FACTOR
ASCE Section 13.5, 13.6 & ASCE Table 13.5-1, 13.6-1 — a_p = 1.0

COMPONENT RESPONSE MODIFICATION FACTOR
ASCE Section 13.5, 13.6 & ASCE Table 13.5-1, 13.6-1 — R_p = 1.5

DESIGN SPECTRAL RESPONSE ACCELERATION — S_{DS} = 0.495

COMPONENT IMPORTANCE FACTOR
ASCE Section 13.1.3 — I_p = 1.00

ATTACHMENT FACTOR IN CONCRETE OR MASONRY
ASCE Tables 13.5-1, 13.6-1 — Ω factor = 2.0

SEISMIC DESIGN FORCE

ASCE Section 13.3.1 & ASCE Equation 13.3-1	$F_p = 0.4 * a_p * S_{DS} * W_p / (R_p / I_p)(1+2z/h)$	F_p = 0.264 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-2	$F_{p.max} = 1.6 * S_{DS} * I_p * W_p$	$F_{p,max}$ = 0.792 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-3	$F_{p,min} = 0.3 * S_{DS} * I_p * W_p$	$F_{p,min}$ = 0.149 Wp

SEISMIC DESIGN FORCES

ASCE Section 13.1.8 & 13.3.1	$F_{p,} = F_{p,govern}$	F_p = 0.264 Wp
ASCE Section 13.1.8 & 13.3.1	$F_{pv} = 0.2 * S_{DS} * W_p$	F_{pv} = 0.099 Wp

DESIGN FORCES

$F_{p,\Omega} = Fp * W_p * \Omega$ factor = 377 lbs

OTM = $z_q * F_{p,\Omega}$ = 15834 lb-in

F_{pv} = 71 lbs

DLRM = $(0.9W_p - F_{pv}) * x_{min}$ = 3203 lb-in

$$T = \frac{OTM - DLRM}{\omega * \#_{T,\omega}} + \frac{0.3 * OTM}{\ell * \#_{T,\ell}}$$

T = 674 lbs

$$V = \frac{F_{p,\Omega} * (2 * y_{max} / L)}{\#_V}$$

V = 94 lbs

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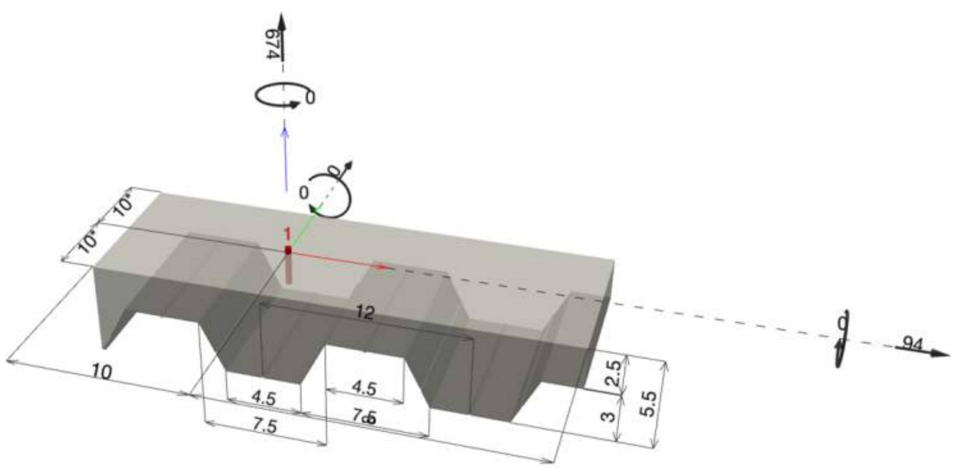
Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/9/2024
Fastening point:			

Specifier's comments:

1 Input data

Metal deck:	Verco W3 Formlok 3"
Metal deck type:	W1
Anchor installation:	On top of concrete-filled metal deck
Anchor type and diameter:	**Kwik Bolt TZ2 - CS 3/8 (2) hnom2**
Item number:	2210236 KB-TZ2 3/8x3
Effective embedment depth:	$h_{ef,act}$ = 2.000 in., h_{nom} = 2.500 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-4266
Issued I Valid:	12/17/2021 | 12/1/2023
Proof:	Design Method ACI 318-19 / Mech in concrete over metal deck installation
Stand-off installation:	
Profile:	
Base material:	cracked lightweight concrete, Custom, f_c' = 3,000 psi; h = 2.500 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

Geometry [in.] & Loading [lb, in.lb]



Input data and results must be checked for conformity with the existing conditions and for plausibility!

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 674; V_x = 94; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	71

2 Load case/Resulting anchor forces

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	674	94	94	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	674	4,869	14	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	674	952	71	OK

* highest loaded anchor **anchor group (anchors in tension)

3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-4266

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.05	126,204

Calculations

N_{sa} [lb]
6,493

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
6,493	0.750	1.000	4,869	674

3.2 Concrete Breakout Failure

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-19 Eq. (17.6.2.1a)

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.000	10.000	1.000	8.000	21	0.600	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
36.00	36.00	1.000	1.000	1,952

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
1,952	0.650	0.750	1.000	952	674

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	94	2,201	5	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	94	1,366	7	OK
Concrete edge failure in direction y-**	94	2,965	4	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value	refer to ICC-ES ESR-4266
$\phi\ V_{steel} \geq V_{ua}$	ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.05	126,204	1.000

Calculations

$V_{sa,eq}$ [lb]
3,386

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ V_{sa,eq}$ [lb]	V_{ua} [lb]
3,386	0.650	1.000	2,201	94

4.2 Pryout Strength

$V_{cp} = k_{cp}\left[\left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$ ACI 318-19 Eq. (17.7.3.1a)

$\phi\ V_{cp} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
1	2.000	10.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
8.000	21	0.600	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
36.00	36.00	1.000	1.000	1,952

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
1,952	0.700	1.000	1.000	1,366	94

4.3 Concrete edge failure in direction y-

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1a)

$\phi\ V_{cb} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
10.000	10.000	1.000	2.500	2.000

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
0.600	0.375	3,000	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
62.50	450.00	1.000	2.449	6,226

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
4,236	0.700	1.000	1.000	2,965	94

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.708	0.069	5/3	58	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

7 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ2 - CS 3/8 (2) hnom2

Item number: 2210236 KB-TZ2 3/8x3

Maximum installation torque: 361 in.lb

Hole diameter in the base material: 0.375 in.

Hole depth in the base material: 2.500 in.

Minimum thickness of the base material: 2.500 in.

Hilti KB-TZ2 stud anchor with 2.5 in embedment, 3/8 (2) hnom2, Carbon steel, installation per ESR-4266

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque controlled cordless impact tool • Torque wrench • Hammer

Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	0.000	10.000	-	10.000	10.000

Company:		Page:	9
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/9/2024
Fastening point:			

8 Remarks; Your Cooperation Duties

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