HGA

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

4610 X STREET
SACRAMENTO, CA 95817

UC Davis
EDUCATION BUILDING IT NETWORK MODERNIZATION
Structural Calculation

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY
William Gilliland
for
UCDH Lead DCFM
DATE: 05/10/2024
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.

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: 05/06/2024
PROJECT #: B24-0075
UC Davis Health
Sacramento, CA 95817

This approval includes 47 pages.

UC DAVIS
HEALTH

FACILITIES DESIGN & CONSTRUCTION
4800 2ND AVENUE SUITE 3010
SACRAMENTO, CALIFORNIA 95817
(916)734-7024

Commission No: 1500-163-01

Date: January 2024
APRIL 2024 BACKCHECK 1 B1

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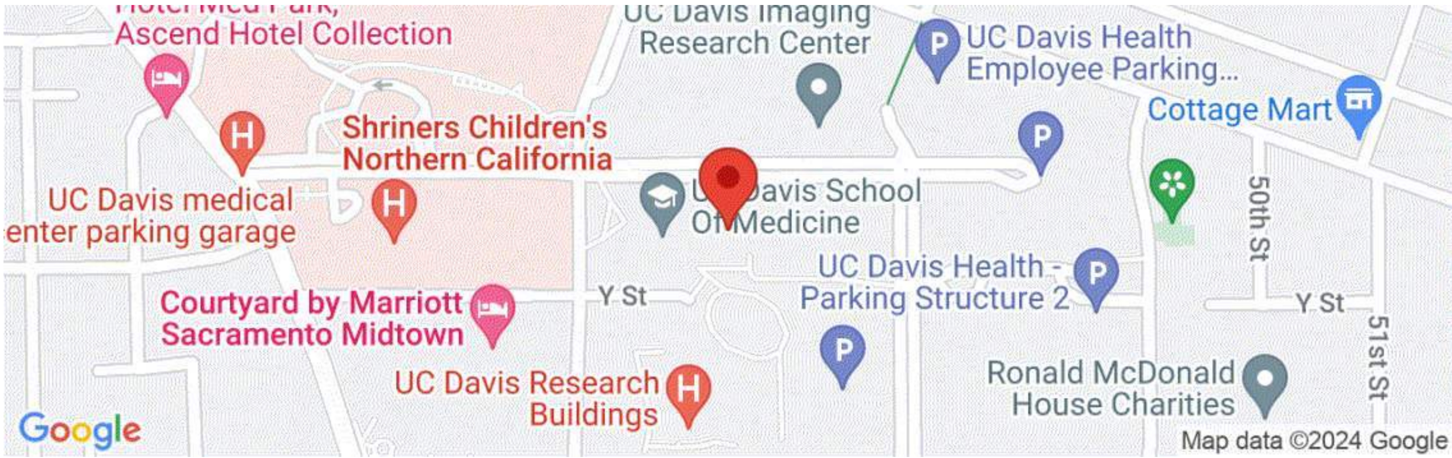
USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

UCD Education Building

4610 X St, Sacramento, CA 95817, USA

Latitude, Longitude: 38.5530128, -121.4519666

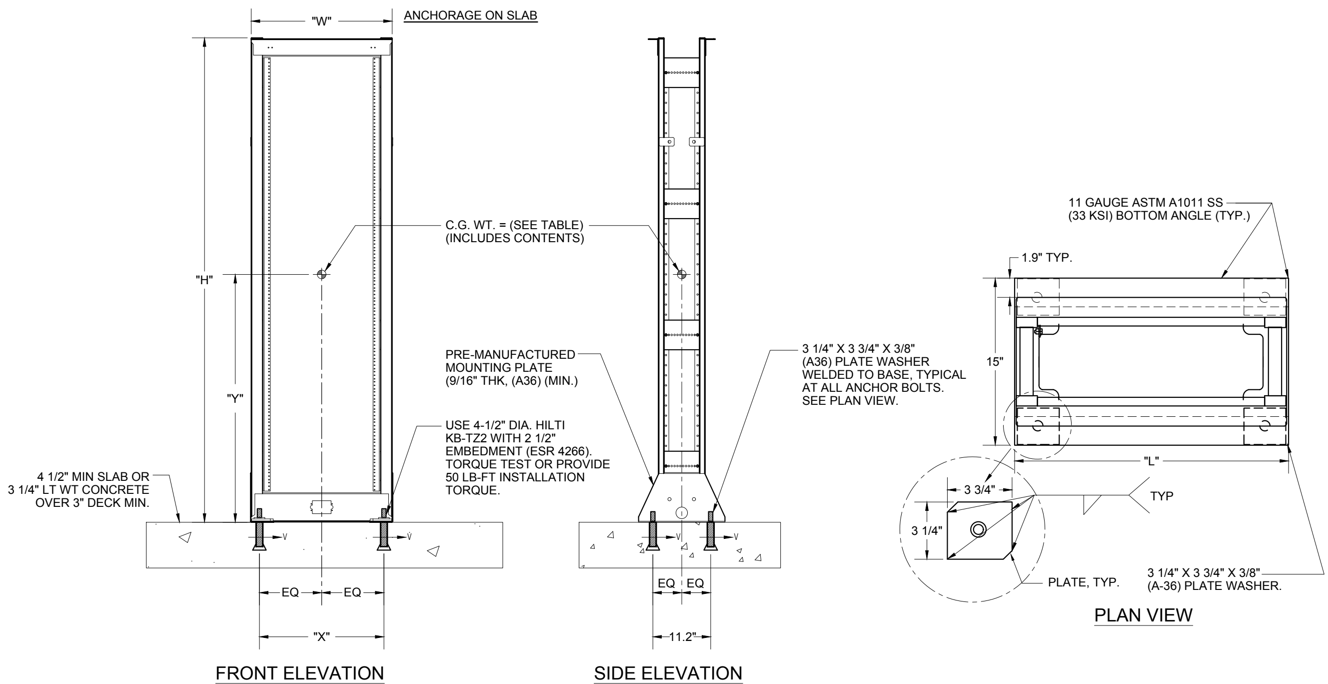


Date	1/2/2024, 12:34:18 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	0.547	MCE_R ground motion. (for 0.2 second period)
S_1	0.247	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.745	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.497	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	1.362	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.23	MCE_G peak ground acceleration
F_{PGA}	1.37	Site amplification factor at PGA
PGA_M	0.315	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	0.547	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.574	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	0.262	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)

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

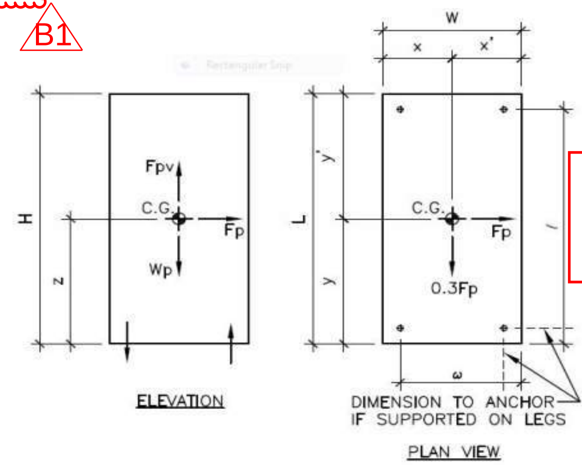
*NOTE: MINIMUM CONCRETE STRENGTH F'C = 3000psi.

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

NO SCALE

2022 **CBC & ASCE 7-16 EQUIP ANCHORAGE FORCES (LRFD) -**

B1



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 = 3.00 ft
Average roof height, h = 4.00 ft

Wt< 2000#, Deck ok per minimum design loads

Level 4 of 4 story building

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 = 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} = 0.497

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 = 0.331 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-2	$F_{p.max} = 1.6*S_{DS}*I_p*W_p$	$F_{p,max}$ = 0.795 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 = 0.331 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 * Ω factor = 473 lbs
OTM = z_q * $F_{p,\Omega}$ = 19872 lb-in
F_{pv} = 71 lbs
DLRM = $(0.9W_p - F_{pv}) * x_{min}$ = 3201 lb-in

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

T = 882 lbs

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

V = 118 lbs

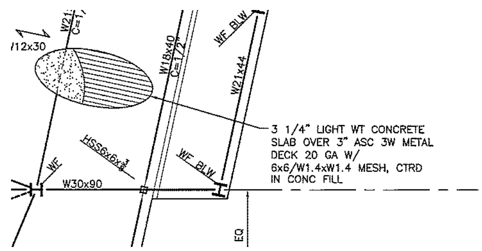
www.hilti.com

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

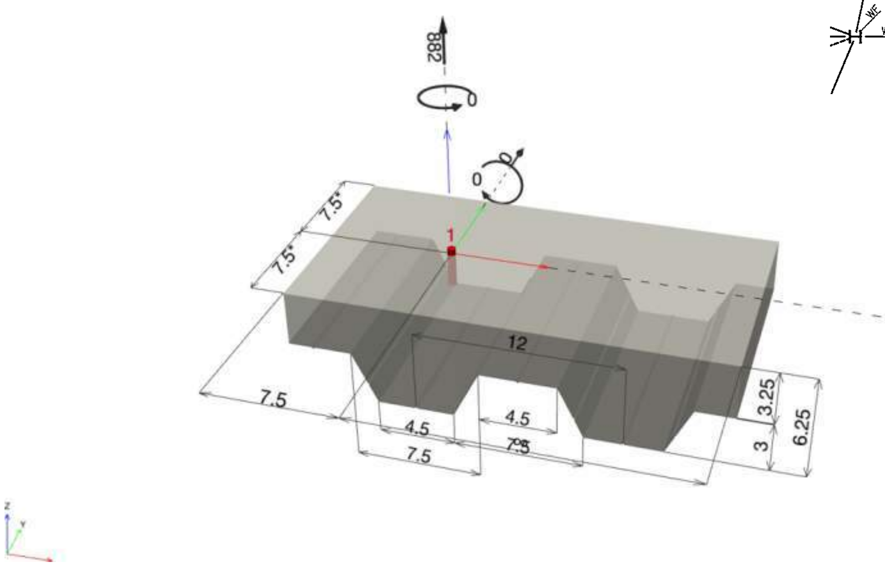
Specifier's comments:

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 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 in concrete over metal deck installation
Stand-off installation:	
Profile:	
Base material:	cracked lightweight concrete, Custom, f_c' = 3,500 psi; h = 3.250 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]



MIX DESIGN SCHEDULE							
TYPE	USE CLASS	STRENGTH "f'c" MIN @ 28 DAYS (PSI)	CONCRETE UNIT WEIGHT (PCF)	MAX AGGREGATE SIZE (IN)	MAX (5) SLUMP (IN)	MAX WATER TO CEMENT RATIO (%)	FLY ASH REPLACEMENT (%)
A	SLAB ON GRADE	4000	150	1"±¼"	4"±1"	.40	15% MIN TO 25% MAX
B	FOUNDATIONS	3500	150	1"±¼"	4"±1"	.45	15% MIN TO 25% MAX
C	WALLS	3500	150	1"±¼"	4"±1"	.45	15% MIN TO 25% MAX
D	SLAB OVER METAL DECK	3500	110	–	4"±1"	.45	0
E	SITE	2500	–	1"±½"	4"±1"	.50	15% MIN TO 25% MAX
F	LEAN MIX	1000	–	–	–	–	–

NOTES:
1. ADD WATER REDUCING ADMIXTURES PER SPECIFICATIONS FOR PLACING.
2. FOR HOT WEATHER CONCRETING REFER TO ACI 305R.
3. FOR COLD WEATHER CONCRETING REFER TO ACI 306R.
4. OTHER ADMIXTURES SHALL BE REVIEWED BY THE ENGINEER OF RECORD AND TESTING LABORATORY UPON CONCRETE MIX DESIGN SUBMITTAL.
5. SLUMPS SHALL NOT EXCEED 8"±1½" WHEN USING MID-RANGE WATER REDUCERS.
6. ADDITIONAL WATER SHALL NOT BE ADDED TO THE CONCRETE ONCE THE TRUCK LEAVES THE BATCH PLANT.

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

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 882; V_x = 118; V_y = 0;$ $M_x = 0; M_y = 0; M_z = 0;$	yes	86

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	882	118	118	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*	882	8,433	11	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	882	1,028	86	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]
0.10	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	882

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	7.500	1.000	7.500	21	0.600	3,500

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	2,108

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
2,108	0.650	0.750	1.000	1,028	882

4 Shear load

	Load V_{ua} [lb]	Capacity $\phi\ V_n$ [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	118	3,599	4	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	118	1,476	8	OK
Concrete edge failure in direction y-**	118	2,986	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]	$\alpha_{V,seis}$
0.10	114,004	1.000

Calculations

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

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ V_{sa,eq}$ [lb]	V_{ua} [lb]
5,537	0.650	1.000	3,599	118

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)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0$ 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

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
1	2.000	7.500	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
7.500	21	0.600	3,500

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	2,108

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \, V_{cp}$ [lb]	V_{ua} [lb]
2,108	0.700	1.000	1.000	1,476	118

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

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.]
7.500	7.500	1.000	3.250	2.000

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
0.600	0.500	3,500	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
60.94	253.12	1.000	1.861	4,762

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \; V_{cb}$ [lb]	V_{ua} [lb]
4,266	0.700	1.000	1.000	2,986	118

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.858	0.080	1.000	79	OK

$\beta_{NV} = (\beta_N + \beta_V) / 1.2 <= 1$

Company:		Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/2/2024
Fastening point:			

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

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: 3.250 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}	c_{+y}
1	0.000	0.000	7.500	-	7.500	7.500

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- 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.

Detail 1/E7.09

Vertiv 40 kVA MAX UPS

B1

UPS OPT WEIGHT
=1032+758=
1790#

B1 B1

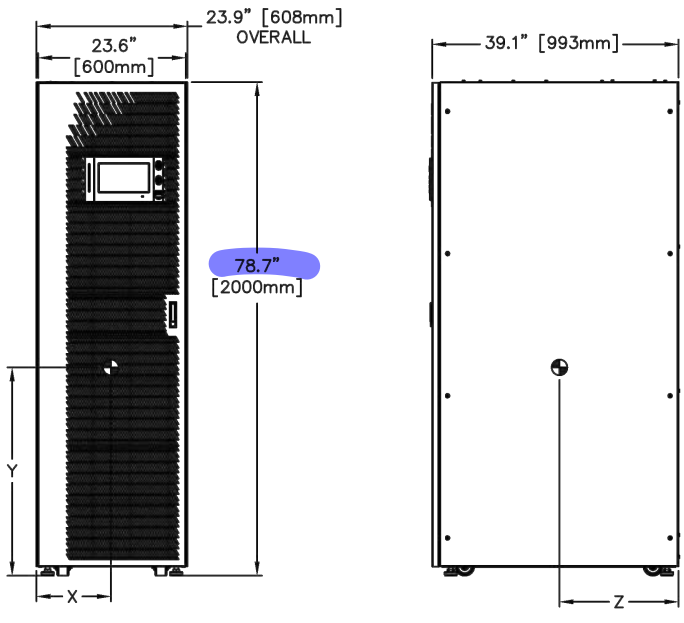
NOT PART of life safety or emergency systems

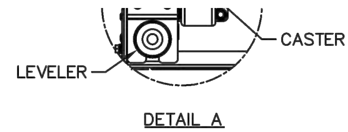
INTERNAL BATTERY STRING		
BATT PN	LBS	KG
12HX100	528	240
12HX150E	624	283
12HX205	1,032	468
HR1500	648	294
HR2000	960	435
HRL12110	524	238
HRL12150	622	282
HRL12200	931	422

THIS CHART APPLIES ONLY TO THE 10-40kVA MODELS.

kVA RATING	UPS HEAT DISSIPATION AT FULL LOAD (BTU/HR)	WEIGHT 40kVA FRAME
10	2,217	684 (320)
15	3,245	684 (320)
20	3,843	684 (320)
30	6,189	758 (344)
40	7,610	758 (344)

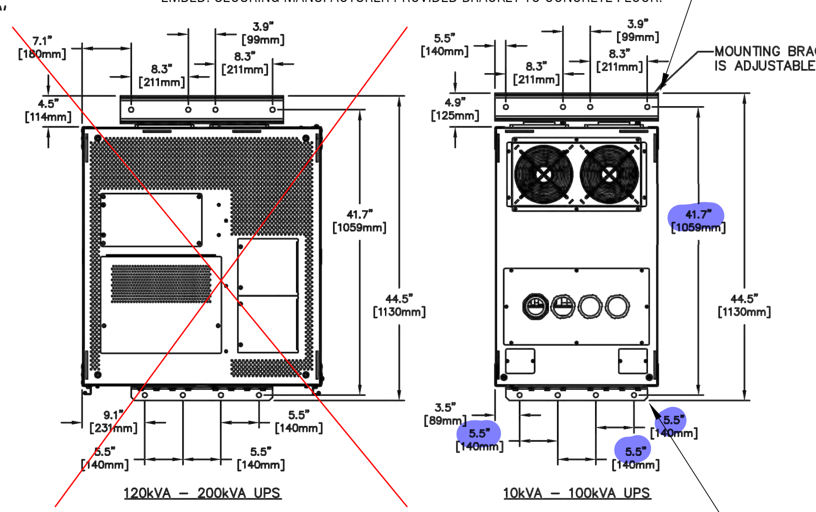
B1





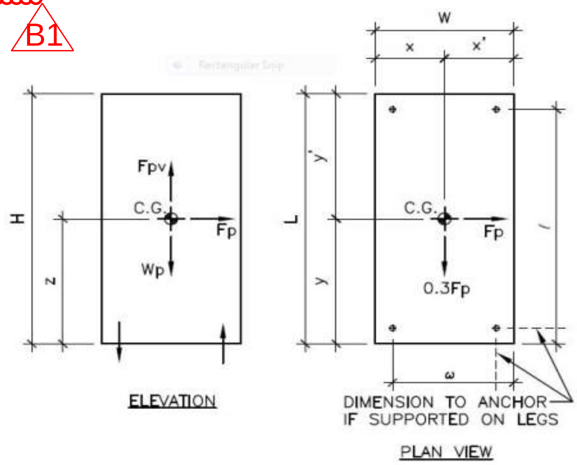
UPS kVA RATING	CENTER OF GRAVITY in(mm)		
	X	Y	Z
10 – 20	11.8"(300mm)	33.1"(840mm)	18.9"(480mm)
30 – 40	11.8"(300mm)	33.1"(840mm)	18.9"(480mm)

TYPICAL- (4) 3/8" HILTI KB-TZ2 EXPANSION ANCHORS WITH 2-1/2" MINIMUM EMBED. SECURING MANUFACTURER PROVIDED BRACKET TO CONCRETE FLOOR.



TYPICAL- (4) 3/8" HILTI KB-TZ2 EXPANSION ANCHORS WITH 2-1/2" MINIMUM EMBED. SECURING MANUFACTURER PROVIDED BRACKET TO CONCRETE FLOOR.

2022 CBC & ASCE 7-16 EQUIP ANCHORAGE FORCES (LRFD) - B1



Height, H = 79.0 in
Height to center of gravity, z_q = 33.1 in
Width, W = 16.5 in
Overturning Dimension, ω = 16.5 in
# of anchors in tension, $\#_{T,\omega}$ = 2
x = 8.3 in
x' = 8.3 in
Length, L = 41.7 in
Overturning Dimension, ℓ = 41.7 in
# of anchors in tension, $\#_{T,\ell}$ = 2
y = 20.9 in
y' = 20.9 in
Weight, W_p = 1790 lbs B1
# of anchors in shear, $\#_V$ = 4
Height of component with respect to grade, z = 3.00 ft
Average roof height, h = 4.00 ft

Wt< 2000#, Deck ok per minimum design loads

Level 4 of 4 story building

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 = 1.0

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} = 0.497

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 = 0.199 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-2	$F_{p.max} = 1.6{*}S_{DS}{*}I_p{*}W_p$	$F_{p,max}$ = 0.795 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 = 0.199 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 * Ω factor = 712 lbs

OTM = z_q * $F_{p,\Omega}$ = 23557 lb-in

F_{pv} = 178 lbs

DLRM = (0.9W_p - F_{pv}) * x_{min} = 11823 lb-in

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

T = 440 lbs

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

V = 178 lbs

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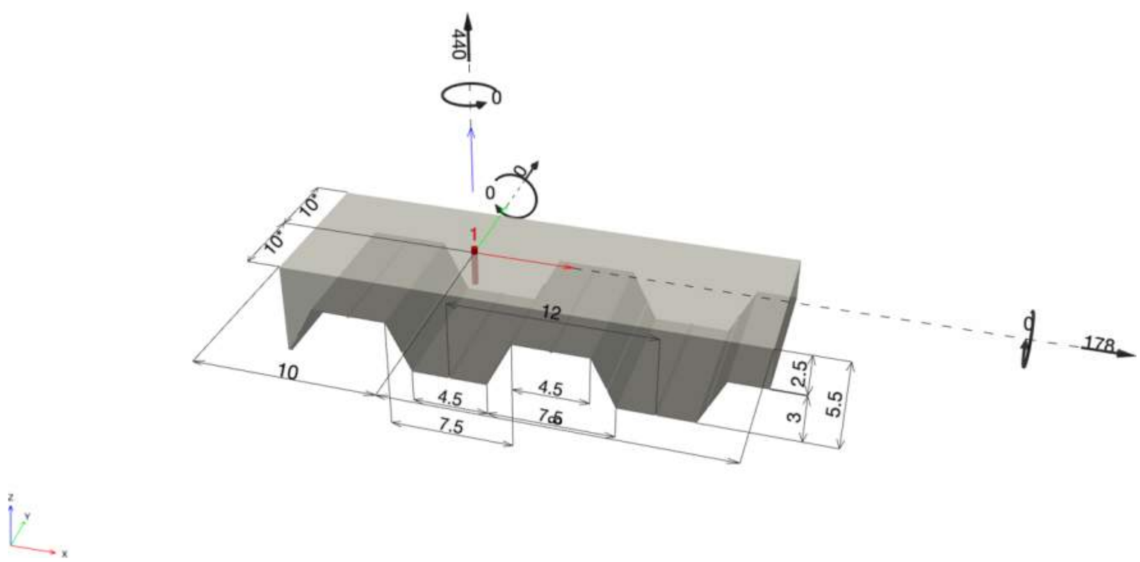
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	3/25/2024
Fastening point:			

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]



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Design:	Metal deck - Jan 2, 2024	Date:	3/25/2024
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 440; V_x = 178; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	47

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	440	178	178	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*	440	4,869	10	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	440	952	47	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	440

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)

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — 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	440

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	178	2,201	9	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	178	1,366	14	OK
Concrete edge failure in direction y-**	178	2,965	7	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]	$\alpha_{V,seis}$
0.05	126,204	1.000

Calculations

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

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
3,386	0.650	1.000	2,201	178

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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)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ 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

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	178

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	178

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.462	0.130	5/3	31	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!

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Design:	Metal deck - Jan 2, 2024	Date:	3/25/2024
Fastening point:			

7 Installation data

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

Profile: -

Item number: 2210236 KB-TZ2 3/8x3

Hole diameter in the fixture: -

Maximum installation torque: 361 in.lb

Plate thickness (input): -

Hole diameter in the base material: 0.375 in.

Hole depth in the base material: 2.500 in.

Drilling method: Hammer drilled

Minimum thickness of the base material: 2.500 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, 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

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Design:	Metal deck - Jan 2, 2024	Date:	3/25/2024
Fastening point:			

8 Remarks; Your Cooperation Duties

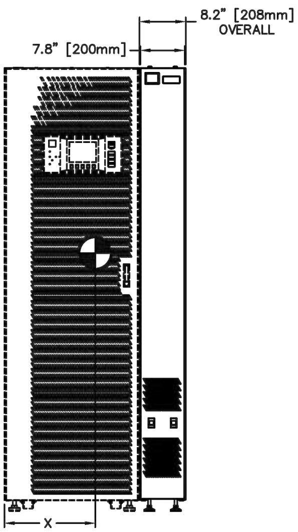
- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- 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.

Detail 1/E7.10

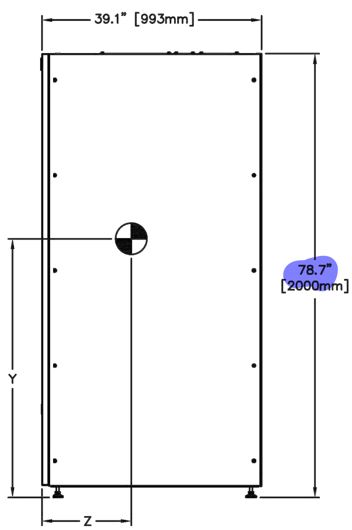
Vertiv UPS BYPASS Cabinet 200 mm

NOT PART of life safety or emergency systems

Liebert EXM MBC 200mm Weight, lb (kg)
240 (109)
240 (109)

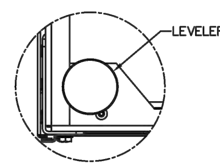


FRONT VIEW
(UPS SHOWN FOR REFERENCE ONLY)

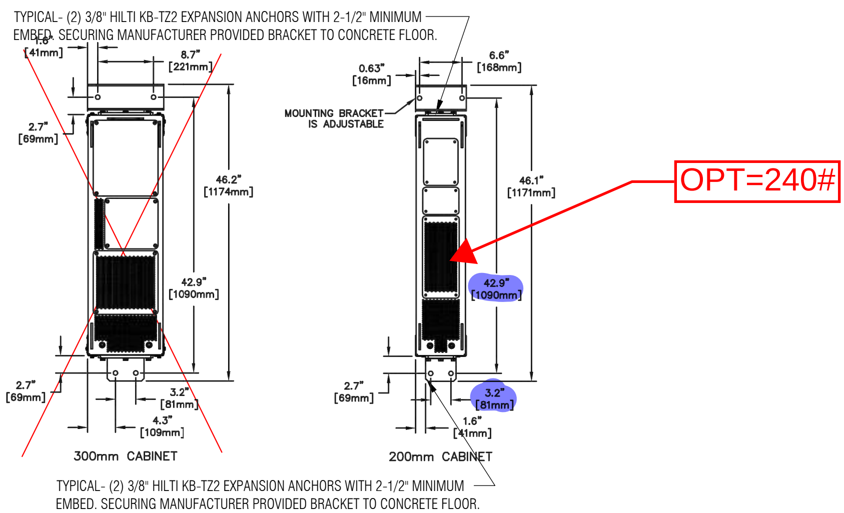


RIGHT SIDE VIEW

UPS kVA RATING	CENTER OF GRAVITY in(mm)			NOTE
	X	Y	Z	
10 – 40	16 (406)	46 (1168)	16.1 (408)	WITH MBC

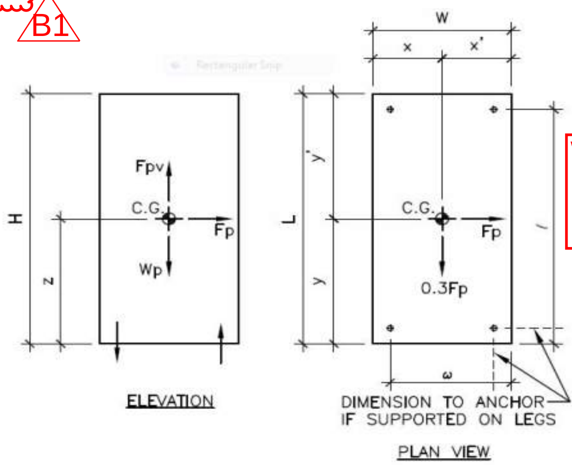


DETAIL A



2022 CBC & ASCE 7-16 EQUIP ANCHORAGE FORCES (LRFD) -

B1



WT<400# CG<4 feet
No seismic Calc
required

Height, H = 79.0 in
Height to center of gravity, z_q = 46.0 in
Width, W = 3.2 in
Overturning Dimension, ω = 3.2 in
# of anchors in tension, $\#_{T,\omega}$ = 2
x = 1.6 in
x' = 1.6 in
Length, L = 42.9 in
Overturning Dimension, ℓ = 42.9 in
# of anchors in tension, $\#_{T,\ell}$ = 2
y = 21.5 in
y' = 21.5 in
Weight, W_p = 240 lbs
# of anchors in shear, $\#_V$ = 4
Height of component with respect to grade, z = 3.00 ft
Average roof height, h = 4.00 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 = 1.0

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} = 0.497

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 = 0.199 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-2	$F_{p.max} = 1.6 S_{DS} I_p W_p$	$F_{p,max}$ = 0.795 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 = 0.199 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 * Ω factor = 95 lbs

OTM = z_q * $F_{p,\Omega}$ = 4390 lb-in

F_{pv} = 24 lbs

DLRM = (0.9W_p - F_{pv}) * x_{min} = 307 lb-in

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

T = 653 lbs

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

V = 24 lbs

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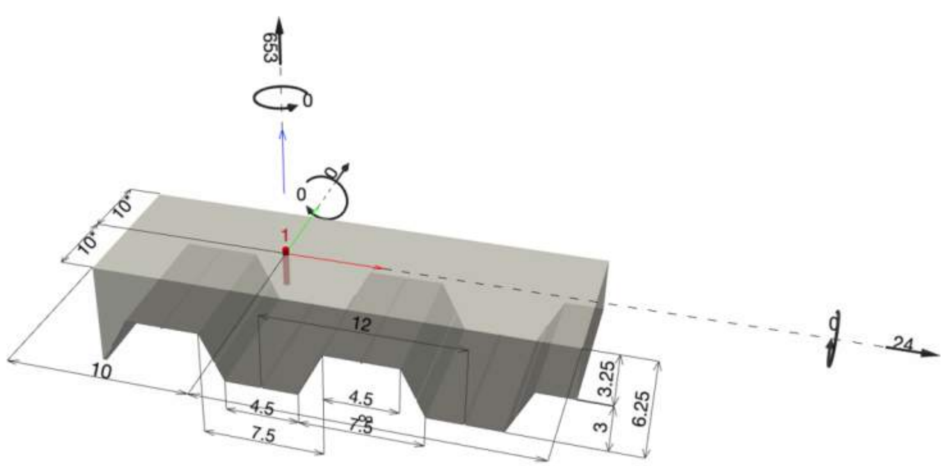
Design:	Metal deck - Jan 2, 2024	Date:	1/2/2024
Fastening point:			

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' = 3,500 psi; h = 3.250 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]



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Design:	Metal deck - Jan 2, 2024	Date:	1/2/2024
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 653; V_x = 24; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	64

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	653	24	24	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*	653	4,869	14	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	653	1,028	64	OK

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

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Fastening point:			

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	653

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	6.000	21	0.600	3,500

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	2,108

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
2,108	0.650	0.750	1.000	1,028	653

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	24	2,201	2	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	24	1,476	2	OK
Concrete edge failure in direction y-**	24	3,652	1	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]	$\alpha_{V,seis}$
0.05	126,204	1.000

Calculations

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

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
3,386	0.650	1.000	2,201	24

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)
$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0$	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

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]
6.000	21	0.600	3,500

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	2,108

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \ V_{cp}$ [lb]	V_{ua} [lb]
2,108	0.700	1.000	1.000	1,476	24

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	3.250	2.000

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
0.600	0.375	3,500	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
81.25	450.00	1.000	2.148	6,725

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
5,217	0.700	1.000	1.000	3,652	24

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.635	0.016	5/3	48	OK

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

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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

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

Profile: -

Item number: 2210236 KB-TZ2 3/8x3

Hole diameter in the fixture: -

Maximum installation torque: 361 in.lb

Plate thickness (input): -

Hole diameter in the base material: 0.375 in.

Hole depth in the base material: 2.500 in.

Drilling method: Hammer drilled

Minimum thickness of the base material: 2.500 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, 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

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8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- 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.

HGA

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

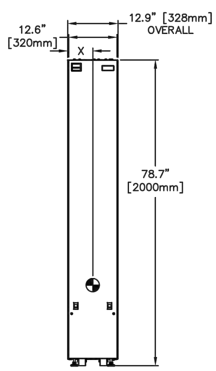
Detail 1/E7.11

Vertiv Battery Cabinet 12HX205

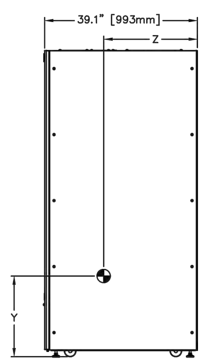
NOT PART of life safety or emergency systems

BATTERY CABINET CIRCUIT BREAKER SCHEDULE					
CABINET	AF / AT	IR SETTING	II SETTING	MFG	MFG PN
320mm	225/225	NA	2250	ABB	XT4NU3225AFF000
600mm	225/225	NA	NA	ABB	XT4NU3225AFF000
600mm	600/465	MED/MIN	3000	ABB	T6N600TWAS2
880mm	225/225	NA	NA	ABB	XT4NU3225AFF000
880mm	600/465	MED/MIN	3000	ABB	T6N600TWAS2

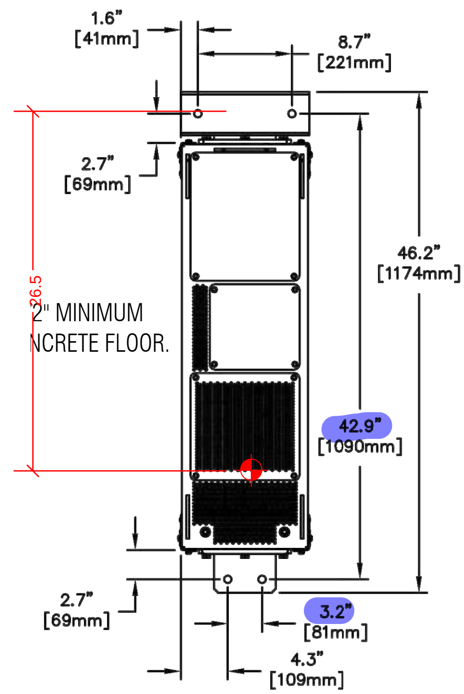
WEIGHT INFORMATION						
CABINET WIDTH	kVA RATING	BATTERY MFG	BATTERY MODEL NO.	BATT CODE	WEIGHT, LBS (KG) UNPACKED	PACKED
320mm	10-40	ENERSYS	12HX150E-FR	HX	1,082 (491)	1,107 (548)
		ENERSYS	12HX205-FR	MX	1,432 (650)	1,557 (707)
		EAST PENN	HR1500	GA	1,106 (502)	1,231 (559)
		EAST PENN	HR2000	LA	1,360 (617)	1,485 (674)
		CSB	HRL12110	FC	1,090 (494)	1,215 (551)
		CSB	HRL12150	HC	1,207 (547)	1,332 (604)
		CSB	HRL12200	MC	1,485 (674)	1,610 (730)



FRONT VIEW



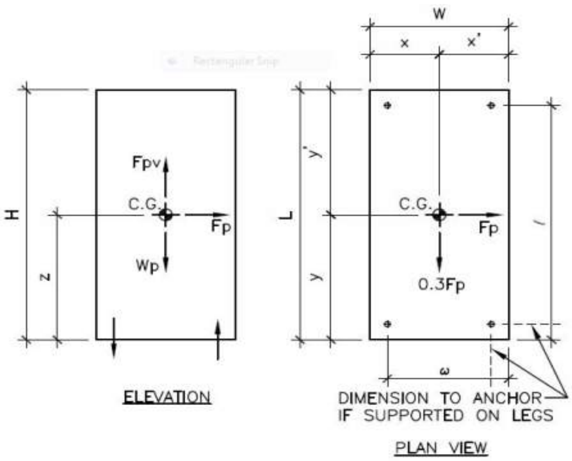
RIGHT SIDE VIEW



BATTERY TYPE	CENTER OF GRAVITY in(mm)		
	X	Y	Z
ENERSYS 12HX150E	6.5" (165mm)	21.1" (536mm)	25.0" (635mm)
ENERSYS 12HX205	6.5" (165mm)	20.7" (526mm)	24.6" (625mm)

B1

2022 CBC & ASCE 7-16 EQUIP ANCHORAGE FORCES (LRFD) -



Height, H = 79.0 in
Height to center of gravity, z_q = 20.7 in
Width, W = 12.9 in
Overturning Dimension, ω = 4.3 in
# of anchors in tension, $\#_{T,\omega}$ = 2
x = 6.5 in
x' = 6.5 in
Length, L = 42.9 in
Overturning Dimension, ℓ = 42.9 in
# of anchors in tension, $\#_{T,\ell}$ = 2
y = 26.5 in
y' = 16.4 in
Weight, W_p = 1432 lbs
# of anchors in shear, $\#_V$ = 4
Height of component with respect to grade, z = 3.00 ft
Average roof height, h = 4.00 ft

Wt< 2000#, Deck ok per minimum design loads

Level 4 of 4 story building

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 = 1.0

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} = 0.497

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 = 0.199 Wp
ASCE Section 13.3.1 & ASCE Equation 13.3-2	$F_{p.max} = 1.6*S_{DS}*I_p*W_p$	$F_{p,max}$ = 0.795 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 = 0.199 Wp
ASCE Section 13.1.8 & 13.3.1	$F_{pv} = 0.2*S_{DS}*W_p$	F_{pv} = 0.099 Wp

DESIGN FORCES

$F_{p,\Omega} = Fp * W_p * \Omega \text{ factor} =$ 569 lbs

$OTM = z_q * F_{p,\Omega} =$ 11786 lb-in

$F_{pv} =$ 142 lbs

$DLRM = (0.9W_p - F_{pv}) * x_{min} =$ 7395 lb-in

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

T = 552 lbs

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

V = 176 lbs

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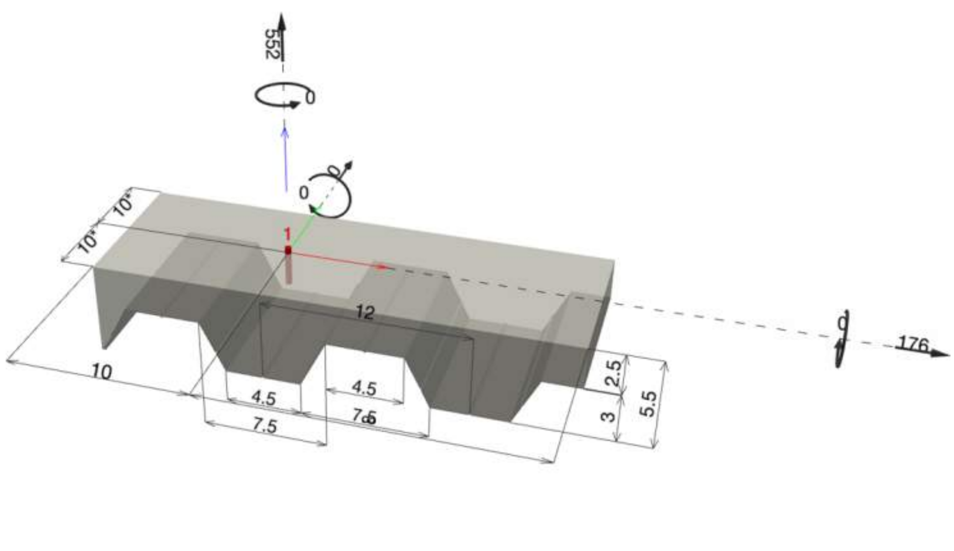
Design:	Metal deck - Jan 2, 2024	Date:	3/25/2024
Fastening point:			

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]



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1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 552; V_x = 176; V_y = 0;$ $M_x = 0; M_y = 0; M_z = 0;$	yes	59

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	552	176	176	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*	552	4,869	12	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	552	952	59	OK

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

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Design:	Metal deck - Jan 2, 2024	Date:	3/25/2024
Fastening point:			

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	552

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	552

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	176	2,201	8	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	176	1,366	13	OK
Concrete edge failure in direction y-**	176	2,965	6	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	176

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	3/25/2024
Fastening point:			

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	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	176

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	176

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.580	0.129	5/3	44	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

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

Profile: -

Item number: 2210236 KB-TZ2 3/8x3

Hole diameter in the fixture: -

Maximum installation torque: 361 in.lb

Plate thickness (input): -

Hole diameter in the base material: 0.375 in.

Hole depth in the base material: 2.500 in.

Drilling method: Hammer drilled

Minimum thickness of the base material: 2.500 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, 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:	3/25/2024
Fastening point:			

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- 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.