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 #25 BUILDING IT
NETWORK MODERNIZATION
Structural Calculation

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Jason Rizzi
UCDH DCFM

DATE: 05/09/2024

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 #: B24-0060

UC Davis Health
Sacramento, CA 95817

This approval includes 64 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
April 2024 - Backcheck #2 B2

TABLE OF CONTENTS

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
ELEVATED DRY TYPE XFMR

HGA

Project	UCD NetV2 MIND #25 Building		
Subject	Elevated Dry Type XFMR-1/E7.01		
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: Elevated Dry Type XFMR

User Inputs		
S_{DS}	0.495	
W_p	590	lbs
a_p	2.5	
R_p	1.5	
I_p	1	
z	1	ft
h	2	ft

Calculations		
F_p(13.3-1)	389.400	lbs
F_p(13.3-2)	467.280	lbs
F_p(13.3-3)	87.615	lbs

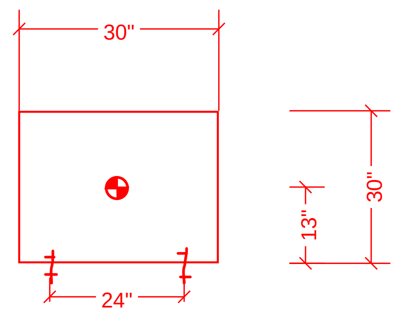
Design Force		
F_p	389.400	lbs

A *vertical* force must be concurrently applied.		
F_{pv} (+)	58.410	lbs
F_{pv} (-)	-58.410	lbs

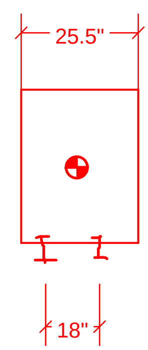
DL=590#/4= 148#
Direction:

T/C= 390#*13"/24"= 211#
V=390#/4=98#

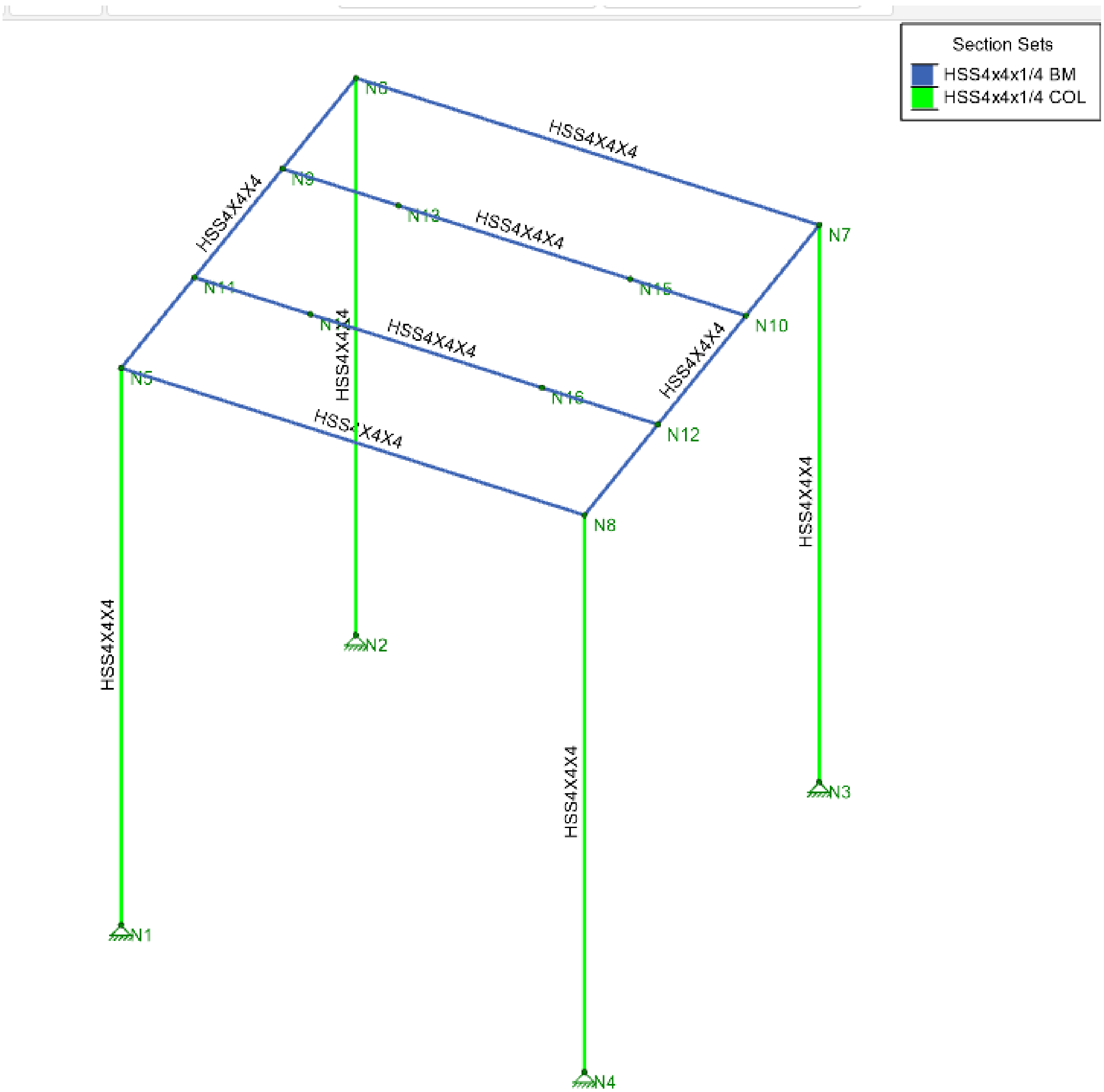
X-Direction:
T/C=390*13"/18"= 282#
V=390#/4=98#



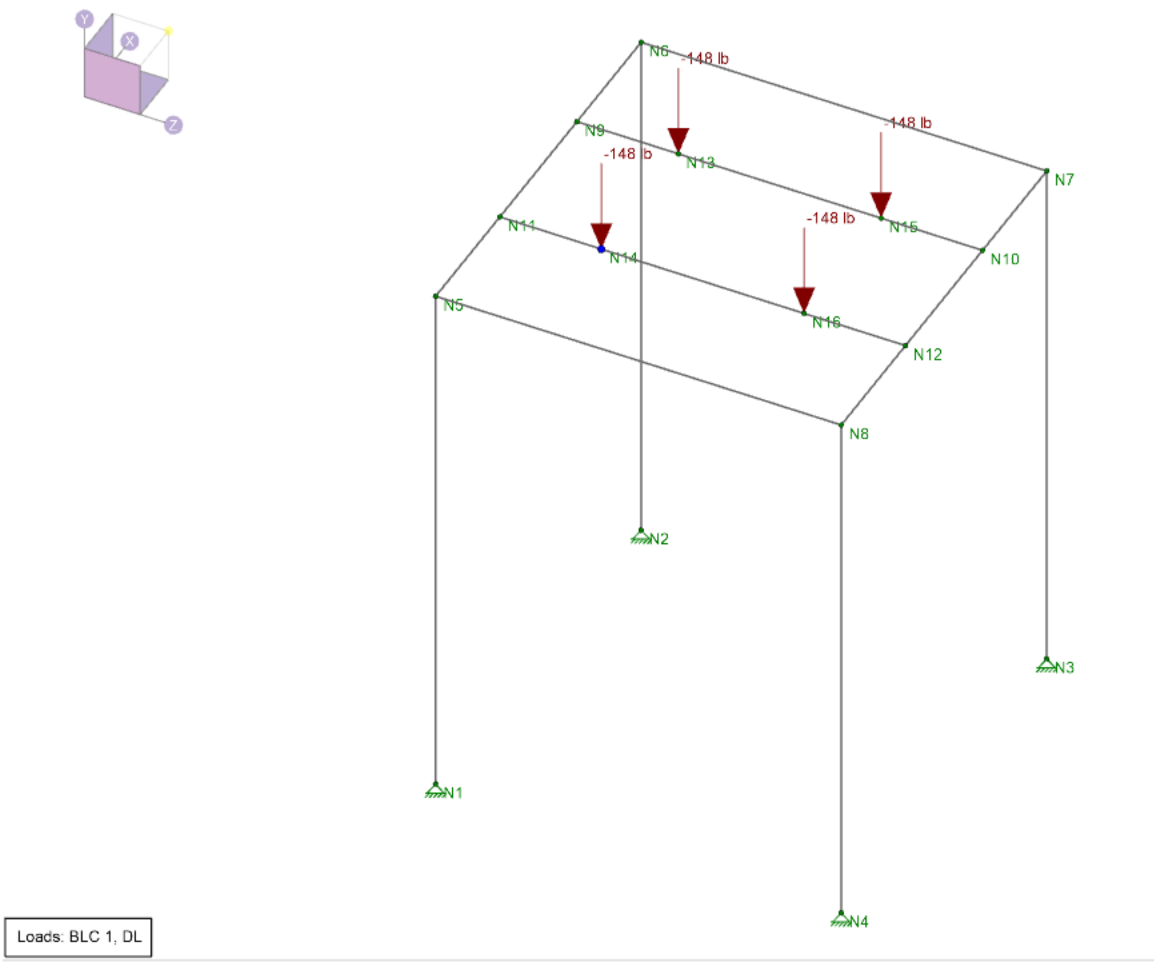
FRONT ELEVATION



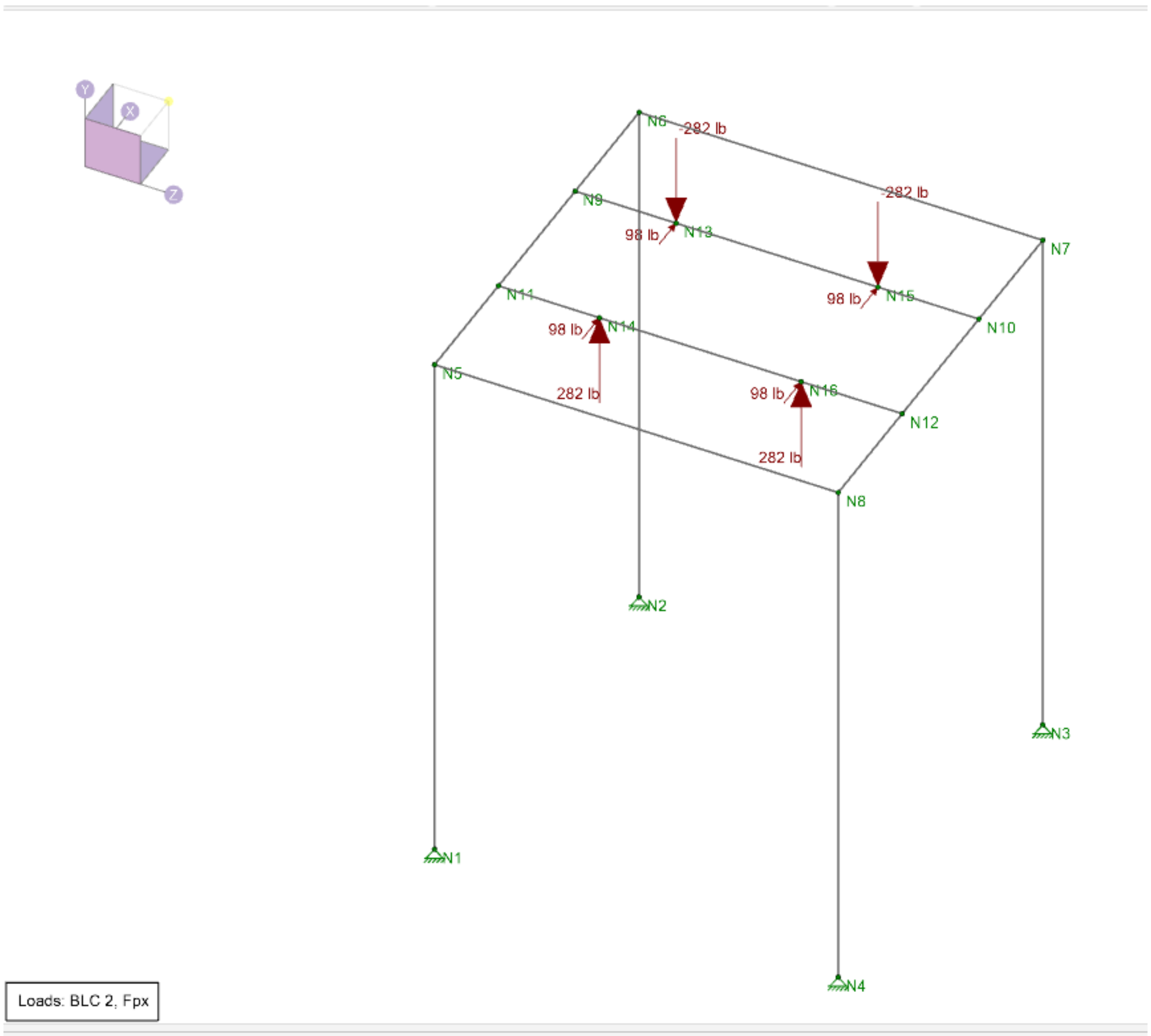
SIDE ELEVATION



MEMBER SIZES


N6
-148 lb
N9
N13
-148 lb
-148 lb
N7
N11
N14
-148 lb
N15
N10
N5
N16
N12
N8
N2
N3
N1
N4
Loads: BLC 1, DL

DL INPUT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N9
98 lb
N13
282 lb
N7
N11
98 lb
N15
98 lb
N14
N10
N5
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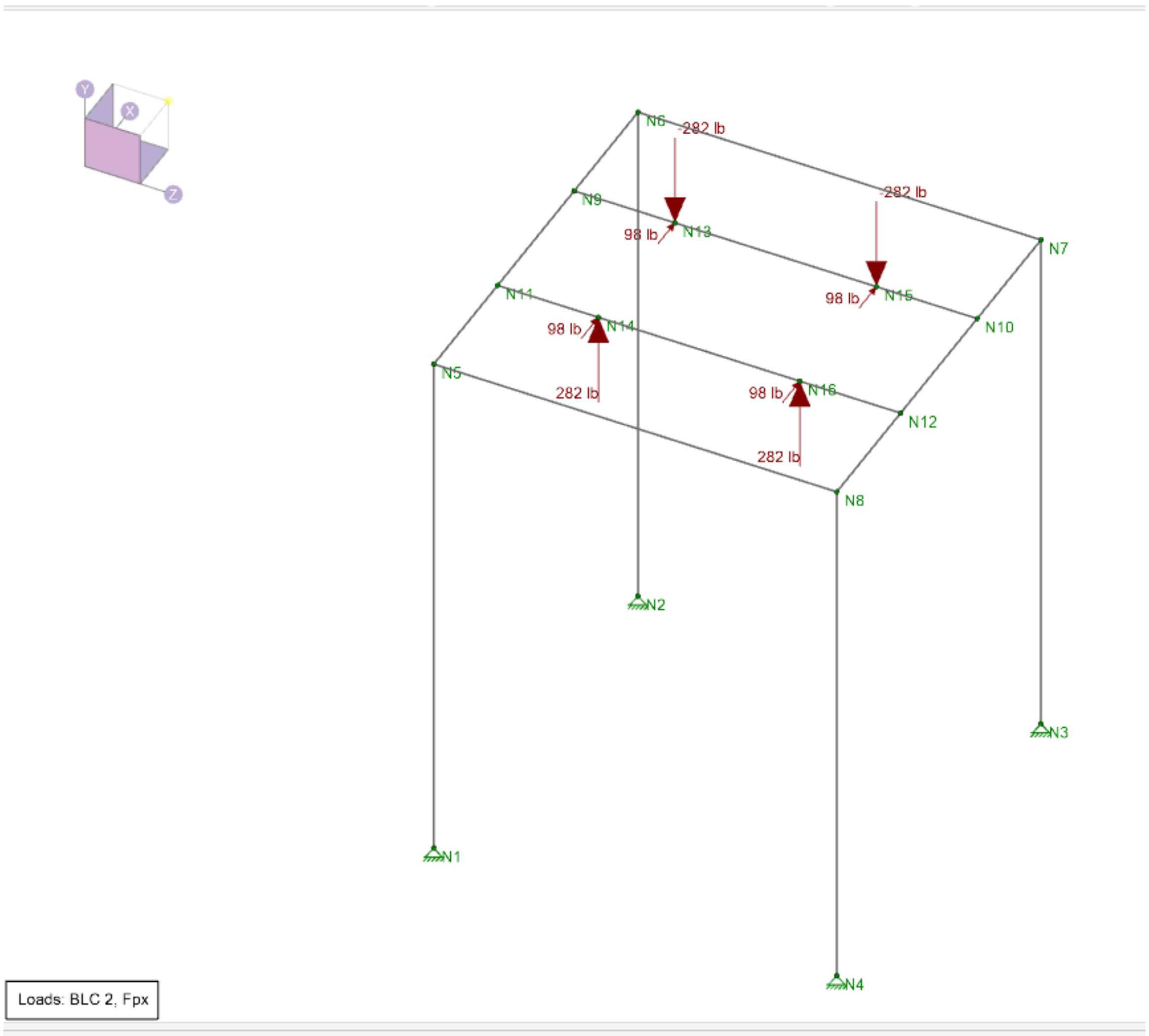
98 lb
N16
N12
282 lb
N8
N2
N3
N1
N4
Loads: BLC 2, Fpx

Fpx INPUT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282 lb
N9
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N13
N7
N11
98 lb
N15
98 lb
N14
N10
N5
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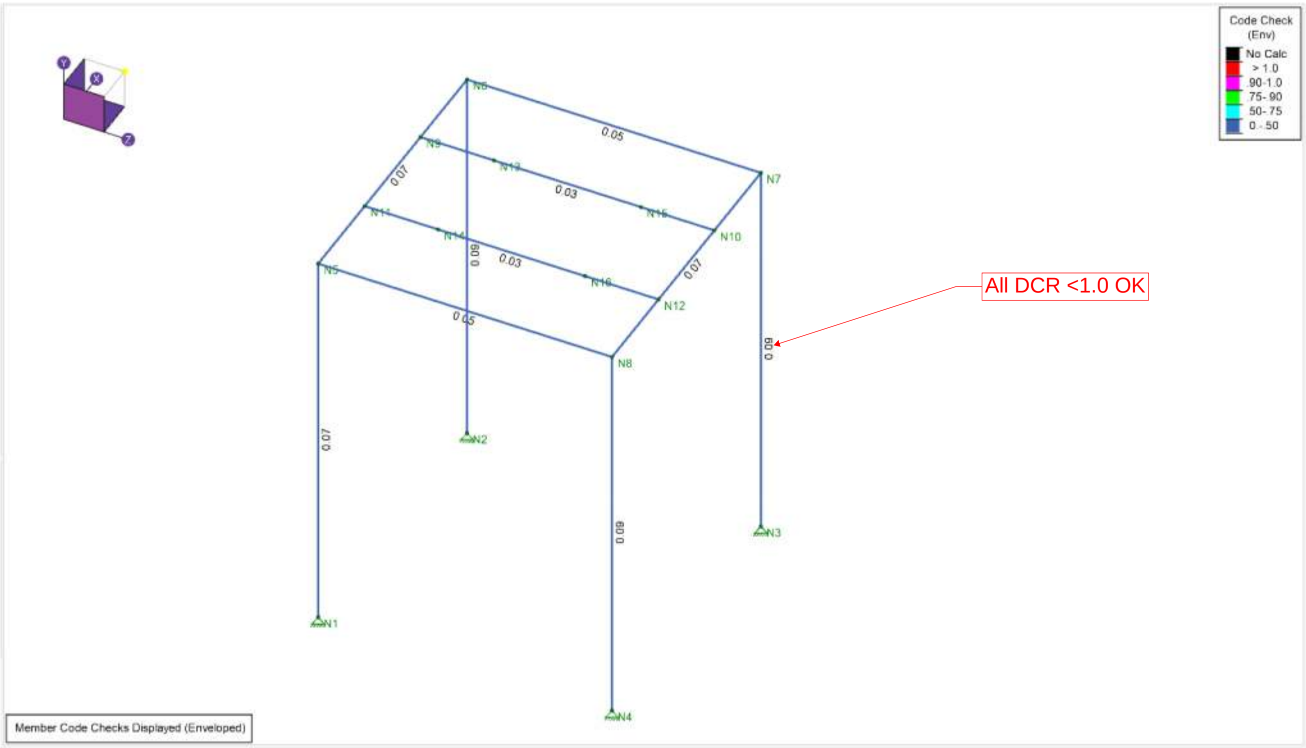
98 lb
N16
N12
282 lb
N8
N2
N3
N1
N4
Loads: BLC 2, Fpx

Fpz INPUT



Envelop DCR

Envelope Node Displacements

	Node Label		X [in]	LC	Y [in]	LC	Z [in]	LC
13	N7	max	0.07	6	0	2	0.069	7
14		min	-0.021	9	-0.001	6	-0.021	8
15	N8	max	0.07	6	0	12	0.069	9
16		min	-0.021	9	-0.001	9	-0.021	8

MAX Node Deflection OK

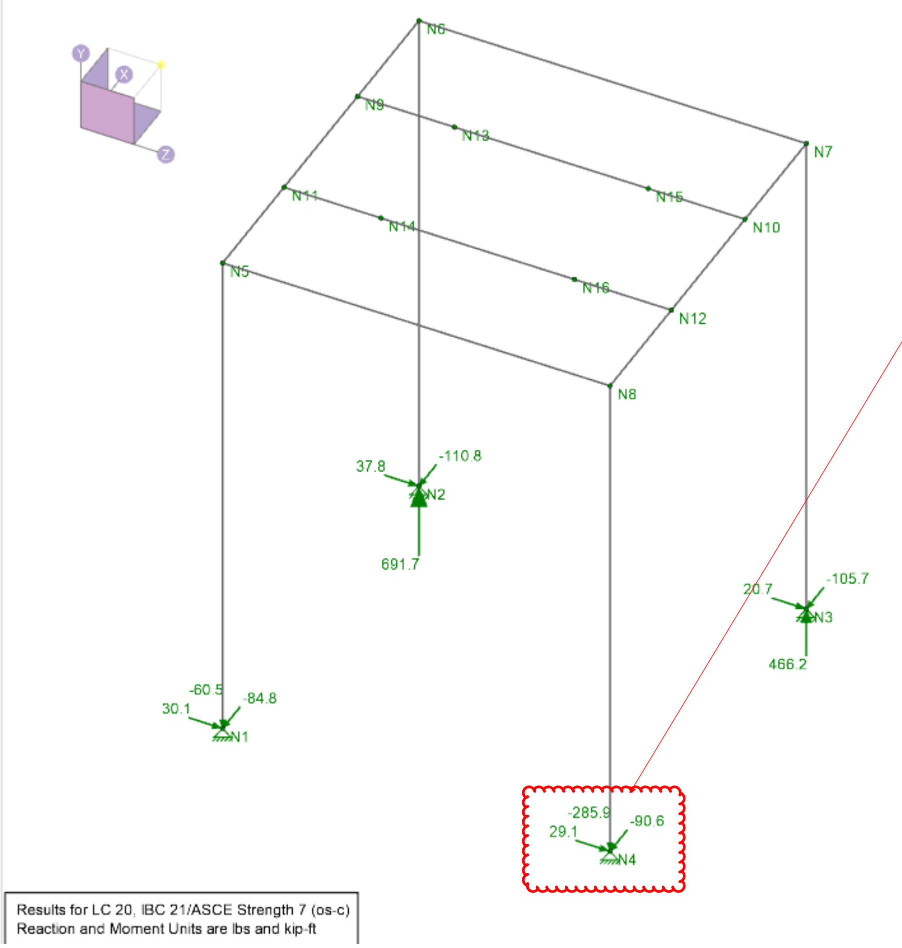
Envelope Node Reactions - Loading...

Regular | Overstrength/Capacity-Limited

Max Reaction downward < 2000#*1.6=3200# (E) Framing ok to support the new load

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC
1	N1	max	42.261	17*	142.197	17*	34.621	16*
2		min	-90.642	18*	-285.931	18*	-95.46	19*
3	N2	max	27.811	21*	895.673	16*	42.341	16*
4		min	-121.705	16*	-285.748	21*	-95.46	21*
5	N3	max	9.293	21*	895.673	14*	20.652	20*
6		min	-121.705	14*	465.867	21*	-107.534	15*
7	N4	max	60.047	17*	895.48	17*	29.124	20*
8		min	-90.642	20*	-285.931	20*	-107.534	17*

Maximum Tension Loads with OS Used for anchorage design



20	IBC 21/ASCE Stre...	✓	Y		DL	0.9	Sds*DL	-0.2	Ω*ELX	1	Ω*ELZ	-0.3

www.hilti.com

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

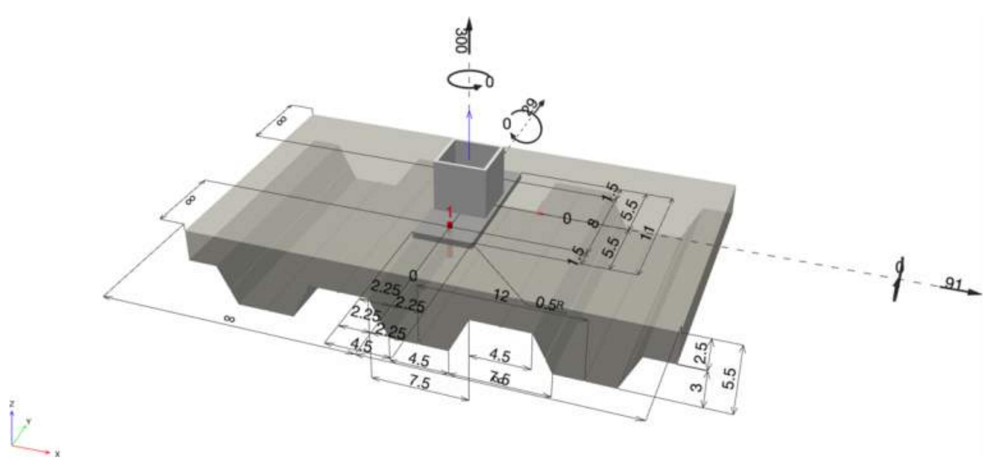
Specifier's comments:

1 Input data

Metal deck:	Verco PLW3 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:	2210237 KB-TZ2 3/8x3 1/2
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:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate^R :	l_x x l_y x t = 4.500 in. x 11.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 in.
Base material:	cracked lightweight concrete, 3000, 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))

^{R} - The anchor calculation is based on a rigid anchor plate assumption.

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



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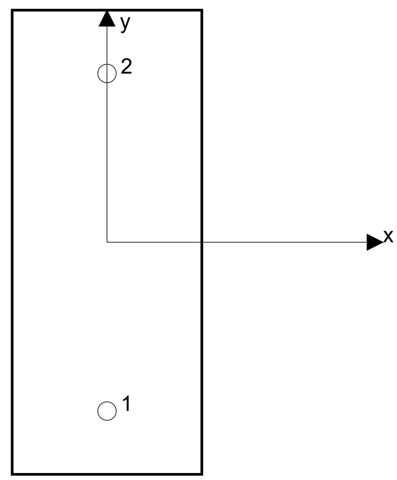
Company:
Address:
Phone I Fax: |
Design: Metal deck - Jan 9, 2024
Fastening point:

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 300; V_x = 91; V_y = 29; M_x = 0; M_y = 0; M_z = 0;	yes	16

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	150	48	45	14
2	150	48	45	14

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]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	150	4,869	4	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	300	1,903	16	OK

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

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 9, 2024	Date:	1/9/2024
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	150

3.2 Concrete Breakout Failure

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

$\phi\ N_{cbg} \geq N_{ua}$ — 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)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — 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.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2.000	0.000	0.000	∞	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}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
72.00	36.00	1.000	1.000	1.000	1.000	1,952

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
3,904	0.650	0.750	1.000	1,903	300

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 9, 2024	Date:	1/9/2024
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity $\phi\ V_n$ [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	48	2,201	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	96	2,733	4	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* 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	48

Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 9, 2024	Date:	1/9/2024
Fastening point:			

4.2 Pryout Strength

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

$\phi\ V_{cpg} \geq V_{ua}$ 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)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0$ 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.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
1	2.000	0.000	0.000	∞

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f_c' [psi]
1.000	8.000	21	0.600	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
72.00	36.00	1.000	1.000	1.000	1.000	1,952

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
3,904	0.700	1.000	1.000	2,733	96

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.158	0.035	5/3	5	OK

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

Company:		Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 9, 2024	Date:	1/9/2024
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!

Company:		Page:	8
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 9, 2024	Date:	1/9/2024
Fastening point:			

7 Installation data

Profile: Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 in.

Hole diameter in the fixture: d_f = 0.438 in.

Plate thickness (input): 0.500 in.

Recommended plate thickness: not calculated

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: 2210237 KB-TZ2 3/8x3 1/2

Maximum installation torque: 361 in.lb

Hole diameter in the base material: 0.375 in.

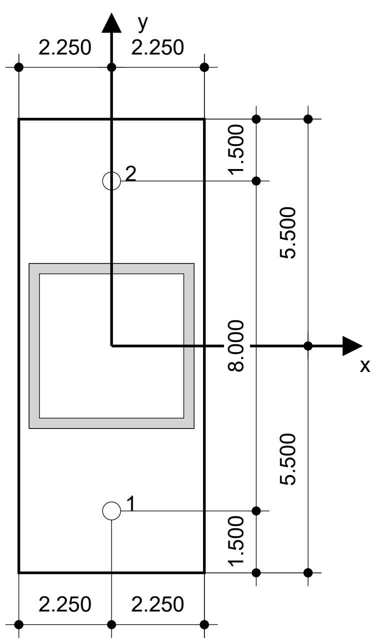
Hole depth in the base material: 2.500 in.

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	-4.000	-	-	-	-
2	0.000	4.000	-	-	-	-

Company:		Page:	9
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 9, 2024	Date:	1/9/2024
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.
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Node Coordinates

	Label	X [in]	Y [in]	Z [in]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	48	0	0	
3	N3	48	0	48	
4	N4	0	0	48	
5	N5	0	66	0	
6	N6	48	66	0	
7	N7	48	66	48	
8	N8	0	66	48	
9	N9	33	66	0	
10	N10	33	66	48	
11	N11	15	66	0	
12	N12	15	66	48	
13	N13	33	66	12	
14	N14	15	66	12	
15	N15	33	66	36	
16	N16	15	66	36	

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N1	Reaction	Reaction	Reaction
2	N2	Reaction	Reaction	Reaction
3	N3	Reaction	Reaction	Reaction
4	N4	Reaction	Reaction	Reaction

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	HSS4x4x1/4 BM	HSS4X4X4	Beam	Tube	A500 Gr.B RECT	Typical	3.37	7.8	7.8	12.8
2	HSS4x4x1/4 COL	HSS4X4X4	Column	Tube	A500 Gr.B RECT	Typical	3.37	7.8	7.8	12.8

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N6	N5	HSS4x4x1/4 BM	Beam	Tube	A500 Gr.B RECT	Typical
2	M2	N5	N8	HSS4x4x1/4 BM	Beam	Tube	A500 Gr.B RECT	Typical
3	M3	N8	N7	HSS4x4x1/4 BM	Beam	Tube	A500 Gr.B RECT	Typical
4	M4	N7	N6	HSS4x4x1/4 BM	Beam	Tube	A500 Gr.B RECT	Typical
5	M5	N2	N6	HSS4x4x1/4 COL	Column	Tube	A500 Gr.B RECT	Typical
6	M6	N1	N5	HSS4x4x1/4 COL	Column	Tube	A500 Gr.B RECT	Typical
7	M7	N3	N7	HSS4x4x1/4 COL	Column	Tube	A500 Gr.B RECT	Typical
8	M8	N4	N8	HSS4x4x1/4 COL	Column	Tube	A500 Gr.B RECT	Typical
9	M9	N9	N10	HSS4x4x1/4 BM	Beam	Tube	A500 Gr.B RECT	Typical
10	M10	N11	N12	HSS4x4x1/4 BM	Beam	Tube	A500 Gr.B RECT	Typical

Node Loads and Enforced Displacements (BLC 1 : DL)

	Node Label	L, D, M	Direction	Magnitude [(lb, k-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N13	L	Y	-148
2	N15	L	Y	-148
3	N14	L	Y	-148
4	N16	L	Y	-148

Node Loads and Enforced Displacements (BLC 2 : Fpx)

	Node Label	L, D, M	Direction	Magnitude [(lb, k-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N13	L	X	98
2	N15	L	X	98
3	N14	L	X	98
4	N16	L	X	98

Node Loads and Enforced Displacements (BLC 2 : Fpx) (Continued)

	Node Label	L, D, M	Direction	Magnitude [(lb, k-ft), (in, rad), (lb*s²/in, lb*s²*in)]
5	N14	L	Y	282
6	N16	L	Y	282
7	N13	L	Y	-282
8	N15	L	Y	-282

Node Loads and Enforced Displacements (BLC 3 : Fpz)

	Node Label	L, D, M	Direction	Magnitude [(lb, k-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N16	L	Y	-211
2	N15	L	Y	-211
3	N14	L	Y	211
4	N13	L	Y	211
5	N15	L	Z	98
6	N16	L	Z	98
7	N14	L	Z	98
8	N13	L	Z	98

Basic Load Cases

	BLC Description	Category	Y Gravity	Nodal
1	DL	DL	-1	4
2	Fpx	ELX		8
3	Fpz	ELZ		8

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	Deflection 1	Yes	Y	DL	1										
2	Deflection 2	Yes	Y	LL	1										
3	Deflection 3	Yes	Y	DL	1	LL	1								
4	IBC 16-1	Yes	Y	DL	1.4										
5	IBC 16-2 (a)	Yes	Y	DL	1.2	LL	1.6	LLS	1.6						
6	IBC 21/ASCE Strength 6 (a)	Yes	Y	DL	1.2	Sds*DL	0.2	ELX	1	ELZ	0.3	LL	0.5	LLS	1
7	IBC 21/ASCE Strength 6 (b)	Yes	Y	DL	1.2	Sds*DL	0.2	ELZ	1	ELX	0.3	LL	0.5	LLS	1
8	IBC 21/ASCE Strength 6 (c)	Yes	Y	DL	1.2	Sds*DL	0.2	ELX	1	ELZ	-0.3	LL	0.5	LLS	1
9	IBC 21/ASCE Strength 6 (d)	Yes	Y	DL	1.2	Sds*DL	0.2	ELZ	1	ELX	-0.3	LL	0.5	LLS	1
10	IBC 21/ASCE Strength 7 (a)	Yes	Y	DL	0.9	Sds*DL	-0.2	ELX	1	ELZ	0.3				
11	IBC 21/ASCE Strength 7 (b)	Yes	Y	DL	0.9	Sds*DL	-0.2	ELZ	1	ELX	0.3				
12	IBC 21/ASCE Strength 7 (c)	Yes	Y	DL	0.9	Sds*DL	-0.2	ELX	1	ELZ	-0.3				
13	IBC 21/ASCE Strength 7 (d)	Yes	Y	DL	0.9	Sds*DL	-0.2	ELZ	1	ELX	-0.3				
14	IBC 21/ASCE Strength 6 (os-a)	Yes	Y	DL	1.2	Sds*DL	0.2	Om*ELX	1	Om*ELZ	0.3	LL	0.5	LLS	1
15	IBC 21/ASCE Strength 6 (os-b)	Yes	Y	DL	1.2	Sds*DL	0.2	Om*ELZ	1	Om*ELX	0.3	LL	0.5	LLS	1
16	IBC 21/ASCE Strength 6 (os-c)	Yes	Y	DL	1.2	Sds*DL	0.2	Om*ELX	1	Om*ELZ	-0.3	LL	0.5	LLS	1
17	IBC 21/ASCE Strength 6 (os-d)	Yes	Y	DL	1.2	Sds*DL	0.2	Om*ELZ	1	Om*ELX	-0.3	LL	0.5	LLS	1
18	IBC 21/ASCE Strength 7 (os-a)	Yes	Y	DL	0.9	Sds*DL	-0.2	Om*ELX	1	Om*ELZ	0.3				
19	IBC 21/ASCE Strength 7 (os-b)	Yes	Y	DL	0.9	Sds*DL	-0.2	Om*ELZ	1	Om*ELX	0.3				
20	IBC 21/ASCE Strength 7 (os-c)	Yes	Y	DL	0.9	Sds*DL	-0.2	Om*ELX	1	Om*ELZ	-0.3				
21	IBC 21/ASCE Strength 7 (os-d)	Yes	Y	DL	0.9	Sds*DL	-0.2	Om*ELZ	1	Om*ELX	-0.3				

Node Reactions

	LC	Node Label	X [lb]	Y [lb]	Z [lb]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
0	1	N1	15.58	289.833	6.527	0	0	0
1	1	N2	-15.58	289.833	6.527	0	0	0
2	1	N3	-15.58	289.833	-6.527	0	0	0
3	1	N4	15.58	289.833	-6.527	0	0	0
4	1	Totals:	0	1159.33	0			
5	1	COG (in):	X: 24	Y: 58.277	Z: 24			
6	2	N1	0	0	0	0	0	0
7	2	N2	0	0	0	0	0	0
8	2	N3	0	0	0	0	0	0
9	2	N4	0	0	0	0	0	0

Node Reactions (Continued)

	LC	Node Label	X [lb]	Y [lb]	Z [lb]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
10	2	Totals:	0	0	0			
11	2	COG (in):	NC	NC	NC			
12	3	N1	15.58	289.833	6.527	0	0	0
13	3	N2	-15.58	289.833	6.527	0	0	0
14	3	N3	-15.58	289.833	-6.527	0	0	0
15	3	N4	15.58	289.833	-6.527	0	0	0
16	3	Totals:	0	1159.33	0			
17	3	COG (in):	X: 24	Y: 58.277	Z: 24			
18	4	N1	21.812	405.766	9.138	0	0	0
19	4	N2	-21.812	405.766	9.138	0	0	0
20	4	N3	-21.812	405.766	-9.138	0	0	0
21	4	N4	21.812	405.766	-9.138	0	0	0
22	4	Totals:	0	1623.063	0			
23	4	COG (in):	X: 24	Y: 58.277	Z: 24			
24	5	N1	18.696	347.799	7.832	0	0	0
25	5	N2	-18.696	347.799	7.832	0	0	0
26	5	N3	-18.696	347.799	-7.832	0	0	0
27	5	N4	18.696	347.799	-7.832	0	0	0
28	5	Totals:	0	1391.196	0			
29	5	COG (in):	X: 24	Y: 58.277	Z: 24			
30	6	N1	-79.743	-84.127	-24.556	0	0	0
31	6	N2	-116.633	669.678	-16.082	0	0	0
32	6	N3	-121.705	895.673	-42.341	0	0	0
33	6	N4	-73.919	141.839	-34.621	0	0	0
34	6	Totals:	-392	1623.063	-117.6			
35	6	COG (in):	X: 30.255	Y: 58.277	Z: 25.872			
36	7	N1	-16.916	-83.934	-90.895	0	0	0
37	7	N2	-42.261	142.197	-88.089	0	0	0
38	7	N3	-60.047	895.48	-107.534	0	0	0
39	7	N4	1.623	669.319	-105.482	0	0	0
40	7	Totals:	-117.6	1623.063	-392			
41	7	COG (in):	X: 25.876	Y: 58.277	Z: 30.24			
42	8	N1	-73.919	141.839	34.621	0	0	0
43	8	N2	-121.705	895.673	42.341	0	0	0
44	8	N3	-116.633	669.678	16.082	0	0	0
45	8	N4	-79.743	-84.127	24.556	0	0	0
46	8	Totals:	-392	1623.063	117.6			
47	8	COG (in):	X: 30.255	Y: 58.277	Z: 22.128			
48	9	N1	42.261	142.197	-88.089	0	0	0
49	9	N2	16.916	-83.934	-90.895	0	0	0
50	9	N3	-1.623	669.319	-105.482	0	0	0
51	9	N4	60.047	895.48	-107.534	0	0	0
52	9	Totals:	117.6	1623.063	-392			
53	9	COG (in):	X: 22.124	Y: 58.277	Z: 30.24			
54	10	N1	-90.642	-285.931	-29.124	0	0	0
55	10	N2	-105.732	466.208	-20.652	0	0	0
56	10	N3	-110.801	691.712	-37.773	0	0	0
57	10	N4	-84.825	-60.457	-30.051	0	0	0
58	10	Totals:	-392	811.531	-117.6			
59	10	COG (in):	X: 36.51	Y: 58.277	Z: 27.744			
60	11	N1	-27.811	-285.748	-95.46	0	0	0
61	11	N2	-31.363	-60.116	-92.656	0	0	0
62	11	N3	-49.133	691.528	-102.969	0	0	0
63	11	N4	-9.293	465.867	-100.915	0	0	0
64	11	Totals:	-117.6	811.531	-392			
65	11	COG (in):	X: 27.753	Y: 58.277	Z: 36.48			
66	12	N1	-84.825	-60.457	30.051	0	0	0
67	12	N2	-110.801	691.712	37.773	0	0	0
68	12	N3	-105.732	466.208	20.652	0	0	0
69	12	N4	-90.642	-285.931	29.124	0	0	0
70	12	Totals:	-392	811.531	117.6			
71	12	COG (in):	X: 36.51	Y: 58.277	Z: 20.256			
72	13	N1	31.363	-60.116	-92.656	0	0	0

Node Reactions (Continued)

	LC	Node Label	X [lb]	Y [lb]	Z [lb]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
73	13	N2	27.811	-285.748	-95.46	0	0	0
74	13	N3	9.293	465.867	-100.915	0	0	0
75	13	N4	49.133	691.528	-102.969	0	0	0
76	13	Totals:	117.6	811.531	-392			
77	13	COG (in):	X: 20.247	Y: 58.277	Z: 36.48			

Node Reactions - Overstrength or Capacity Limit

	LC	Node Label	X [lb]	Y [lb]	Z [lb]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
0	14*	N1	-79.743	-84.127	-24.556	0	0	0
1	14*	N2	-116.633	669.678	-16.082	0	0	0
2	14*	N3	-121.705	895.673	-42.341	0	0	0
3	14*	N4	-73.919	141.839	-34.621	0	0	0
4	14*	Totals:	-392	1623.063	-117.6			
5	14*	COG (in):	X: 30.255	Y: 58.277	Z: 25.872			
6	15*	N1	-16.916	-83.934	-90.895	0	0	0
7	15*	N2	-42.261	142.197	-88.089	0	0	0
8	15*	N3	-60.047	895.48	-107.534	0	0	0
9	15*	N4	1.623	669.319	-105.482	0	0	0
10	15*	Totals:	-117.6	1623.063	-392			
11	15*	COG (in):	X: 25.876	Y: 58.277	Z: 30.24			
12	16*	N1	-73.919	141.839	34.621	0	0	0
13	16*	N2	-121.705	895.673	42.341	0	0	0
14	16*	N3	-116.633	669.678	16.082	0	0	0
15	16*	N4	-79.743	-84.127	24.556	0	0	0
16	16*	Totals:	-392	1623.063	117.6			
17	16*	COG (in):	X: 30.255	Y: 58.277	Z: 22.128			
18	17*	N1	42.261	142.197	-88.089	0	0	0
19	17*	N2	16.916	-83.934	-90.895	0	0	0
20	17*	N3	-1.623	669.319	-105.482	0	0	0
21	17*	N4	60.047	895.48	-107.534	0	0	0
22	17*	Totals:	117.6	1623.063	-392			
23	17*	COG (in):	X: 22.124	Y: 58.277	Z: 30.24			
24	18*	N1	-90.642	-285.931	-29.124	0	0	0
25	18*	N2	-105.732	466.208	-20.652	0	0	0
26	18*	N3	-110.801	691.712	-37.773	0	0	0
27	18*	N4	-84.825	-60.457	-30.051	0	0	0
28	18*	Totals:	-392	811.531	-117.6			
29	18*	COG (in):	X: 36.51	Y: 58.277	Z: 27.744			
30	19*	N1	-27.811	-285.748	-95.46	0	0	0
31	19*	N2	-31.363	-60.116	-92.656	0	0	0
32	19*	N3	-49.133	691.528	-102.969	0	0	0
33	19*	N4	-9.293	465.867	-100.915	0	0	0
34	19*	Totals:	-117.6	811.531	-392			
35	19*	COG (in):	X: 27.753	Y: 58.277	Z: 36.48			
36	20*	N1	-84.825	-60.457	30.051	0	0	0
37	20*	N2	-110.801	691.712	37.773	0	0	0
38	20*	N3	-105.732	466.208	20.652	0	0	0
39	20*	N4	-90.642	-285.931	29.124	0	0	0
40	20*	Totals:	-392	811.531	117.6			
41	20*	COG (in):	X: 36.51	Y: 58.277	Z: 20.256			
42	21*	N1	31.363	-60.116	-92.656	0	0	0
43	21*	N2	27.811	-285.748	-95.46	0	0	0
44	21*	N3	9.293	465.867	-100.915	0	0	0
45	21*	N4	49.133	691.528	-102.969	0	0	0
46	21*	Totals:	117.6	811.531	-392			
47	21*	COG (in):	X: 20.247	Y: 58.277	Z: 36.48			

Node Displacements

	LC	Node Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
0	1	N1	0	0	0	-2.579e-5	1.179e-7	6.155e-5
1	1	N2	0	0	0	-2.579e-5	-1.179e-7	-6.155e-5
2	1	N3	0	0	0	2.579e-5	1.179e-7	-6.155e-5
3	1	N4	0	0	0	2.579e-5	-1.179e-7	6.155e-5
4	1	N5	0	0	0	5.277e-5	1.179e-7	-1.26e-4
5	1	N6	0	0	0	5.277e-5	-1.179e-7	1.26e-4
6	1	N7	0	0	0	-5.277e-5	1.179e-7	1.26e-4
7	1	N8	0	0	0	-5.277e-5	-1.179e-7	-1.26e-4
8	1	N9	0	-0.002	0	1.191e-4	-7.209e-8	9.171e-5
9	1	N10	0	-0.002	0	-1.191e-4	7.209e-8	9.171e-5
10	1	N11	0	-0.002	0	1.191e-4	7.209e-8	-9.171e-5
11	1	N12	0	-0.002	0	-1.191e-4	-7.209e-8	-9.171e-5
12	1	N13	0	-0.004	0	9.39e-5	-3.605e-8	9.171e-5
13	1	N14	0	-0.004	0	9.39e-5	3.605e-8	-9.171e-5
14	1	N15	0	-0.004	0	-9.39e-5	3.605e-8	9.171e-5
15	1	N16	0	-0.004	0	-9.39e-5	-3.605e-8	-9.171e-5
16	2	N1	0	0	0	0	0	0
17	2	N2	0	0	0	0	0	0
18	2	N3	0	0	0	0	0	0
19	2	N4	0	0	0	0	0	0
20	2	N5	0	0	0	0	0	0
21	2	N6	0	0	0	0	0	0
22	2	N7	0	0	0	0	0	0
23	2	N8	0	0	0	0	0	0
24	2	N9	0	0	0	0	0	0
25	2	N10	0	0	0	0	0	0
26	2	N11	0	0	0	0	0	0
27	2	N12	0	0	0	0	0	0
28	2	N13	0	0	0	0	0	0
29	2	N14	0	0	0	0	0	0
30	2	N15	0	0	0	0	0	0
31	2	N16	0	0	0	0	0	0
32	3	N1	0	0	0	-2.579e-5	1.179e-7	6.155e-5
33	3	N2	0	0	0	-2.579e-5	-1.179e-7	-6.155e-5
34	3	N3	0	0	0	2.579e-5	1.179e-7	-6.155e-5
35	3	N4	0	0	0	2.579e-5	-1.179e-7	6.155e-5
36	3	N5	0	0	0	5.277e-5	1.179e-7	-1.26e-4
37	3	N6	0	0	0	5.277e-5	-1.179e-7	1.26e-4
38	3	N7	0	0	0	-5.277e-5	1.179e-7	1.26e-4
39	3	N8	0	0	0	-5.277e-5	-1.179e-7	-1.26e-4
40	3	N9	0	-0.002	0	1.191e-4	-7.209e-8	9.171e-5
41	3	N10	0	-0.002	0	-1.191e-4	7.209e-8	9.171e-5
42	3	N11	0	-0.002	0	1.191e-4	7.209e-8	-9.171e-5
43	3	N12	0	-0.002	0	-1.191e-4	-7.209e-8	-9.171e-5
44	3	N13	0	-0.004	0	9.39e-5	-3.605e-8	9.171e-5
45	3	N14	0	-0.004	0	9.39e-5	3.605e-8	-9.171e-5
46	3	N15	0	-0.004	0	-9.39e-5	3.605e-8	9.171e-5
47	3	N16	0	-0.004	0	-9.39e-5	-3.605e-8	-9.171e-5
48	4	N1	0	0	0	-3.61e-5	1.65e-7	8.618e-5
49	4	N2	0	0	0	-3.61e-5	-1.65e-7	-8.618e-5
50	4	N3	0	0	0	3.61e-5	1.65e-7	-8.618e-5
51	4	N4	0	0	0	3.61e-5	-1.65e-7	8.618e-5
52	4	N5	0	0	0	7.388e-5	1.65e-7	-1.763e-4
53	4	N6	0	0	0	7.388e-5	-1.65e-7	1.763e-4
54	4	N7	0	0	0	-7.388e-5	1.65e-7	1.763e-4
55	4	N8	0	0	0	-7.388e-5	-1.65e-7	-1.763e-4
56	4	N9	0	-0.003	0	1.667e-4	-1.009e-7	1.284e-4
57	4	N10	0	-0.003	0	-1.667e-4	1.009e-7	1.284e-4
58	4	N11	0	-0.003	0	1.667e-4	1.009e-7	-1.284e-4
59	4	N12	0	-0.003	0	-1.667e-4	-1.009e-7	-1.284e-4
60	4	N13	0	-0.005	0	1.315e-4	-5.047e-8	1.284e-4
61	4	N14	0	-0.005	0	1.315e-4	5.047e-8	-1.284e-4
62	4	N15	0	-0.005	0	-1.315e-4	5.047e-8	1.284e-4

Node Displacements (Continued)

	LC	Node Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
63	4	N16	0	-0.005	0	-1.315e-4	-5.047e-8	-1.284e-4
64	5	N1	0	0	0	-3.095e-5	1.414e-7	7.387e-5
65	5	N2	0	0	0	-3.095e-5	-1.414e-7	-7.387e-5
66	5	N3	0	0	0	3.095e-5	1.414e-7	-7.387e-5
67	5	N4	0	0	0	3.095e-5	-1.414e-7	7.387e-5
68	5	N5	0	0	0	6.332e-5	1.414e-7	-1.512e-4
69	5	N6	0	0	0	6.332e-5	-1.414e-7	1.512e-4
70	5	N7	0	0	0	-6.332e-5	1.414e-7	1.512e-4
71	5	N8	0	0	0	-6.332e-5	-1.414e-7	-1.512e-4
72	5	N9	0	-0.003	0	1.429e-4	-8.651e-8	1.1e-4
73	5	N10	0	-0.003	0	-1.429e-4	8.651e-8	1.1e-4
74	5	N11	0	-0.003	0	1.429e-4	8.651e-8	-1.1e-4
75	5	N12	0	-0.003	0	-1.429e-4	-8.651e-8	-1.1e-4
76	5	N13	0	-0.005	0	1.127e-4	-4.326e-8	1.1e-4
77	5	N14	0	-0.005	0	1.127e-4	4.326e-8	-1.1e-4
78	5	N15	0	-0.005	0	-1.127e-4	4.326e-8	1.1e-4
79	5	N16	0	-0.005	0	-1.127e-4	-4.326e-8	-1.1e-4
80	6	N1	0	0	0	4.106e-4	-1.157e-5	-1.379e-3
81	6	N2	0	0	0	3.784e-4	5.763e-6	-1.53e-3
82	6	N3	0	0	0	4.828e-4	1.199e-5	-1.552e-3
83	6	N4	0	0	0	4.506e-4	-6.005e-6	-1.358e-3
84	6	N5	0.07	0	0.021	1.158e-4	-1.157e-5	-4.224e-4
85	6	N6	0.07	-0.001	0.021	1.811e-4	5.763e-6	-1.137e-4
86	6	N7	0.07	-0.001	0.021	-3.192e-5	1.199e-5	-6.973e-5
87	6	N8	0.07	0	0.021	3.33e-5	-6.005e-6	-4.664e-4
88	6	N9	0.07	-0.002	0.021	2.82e-4	1.695e-5	1.487e-4
89	6	N10	0.07	-0.003	0.021	-2.245e-4	-4.703e-6	1.822e-4
90	6	N11	0.07	-0.003	0.021	1.09e-4	4.914e-6	-7.453e-5
91	6	N12	0.07	-0.004	0.021	-5.145e-5	-1.714e-5	-1.08e-4
92	6	N13	0.071	-0.006	0.021	2.505e-4	2.468e-5	1.571e-4
93	6	N14	0.071	-0.004	0.021	5.177e-5	2.551e-5	-8.29e-5
94	6	N15	0.071	-0.007	0.021	-2.111e-4	-2.514e-5	1.739e-4
95	6	N16	0.071	-0.005	0.021	-1.242e-5	-2.451e-5	-9.966e-5
96	7	N1	0	0	0	1.404e-3	-3.013e-5	-3.863e-4
97	7	N2	0	0	0	1.394e-3	2.844e-5	-4.865e-4
98	7	N3	0	0	0	1.476e-3	3.052e-5	-5.587e-4
99	7	N4	0	0	0	1.467e-3	-2.867e-5	-3.143e-4
100	7	N5	0.021	0	0.069	3.126e-4	-3.013e-5	-1.835e-4
101	7	N6	0.021	0	0.069	3.322e-4	2.844e-5	2.267e-5
102	7	N7	0.021	-0.001	0.069	1.649e-4	3.052e-5	1.692e-4
103	7	N8	0.021	-0.001	0.069	1.845e-4	-2.867e-5	-3.3e-4
104	7	N9	0.021	-0.001	0.07	2.886e-4	2.358e-5	8.366e-5
105	7	N10	0.021	-0.005	0.07	-9.682e-5	1.721e-5	1.954e-4
106	7	N11	0.021	-0.002	0.07	2.366e-4	-1.701e-5	-6.14e-5
107	7	N12	0.021	-0.005	0.07	-4.49e-5	-2.375e-5	-1.731e-4
108	7	N13	0.021	-0.005	0.07	2.268e-4	6.365e-6	1.116e-4
109	7	N14	0.021	-0.004	0.07	1.672e-4	8.884e-6	-8.933e-5
110	7	N15	0.021	-0.007	0.07	-9.569e-5	-8.516e-6	1.674e-4
111	7	N16	0.021	-0.006	0.07	-3.607e-5	-6.186e-6	-1.452e-4
112	8	N1	0	0	0	-4.506e-4	6.005e-6	-1.358e-3
113	8	N2	0	0	0	-4.828e-4	-1.199e-5	-1.552e-3
114	8	N3	0	0	0	-3.784e-4	-5.763e-6	-1.53e-3
115	8	N4	0	0	0	-4.106e-4	1.157e-5	-1.379e-3
116	8	N5	0.07	0	-0.021	-3.33e-5	6.005e-6	-4.664e-4
117	8	N6	0.07	-0.001	-0.021	3.192e-5	-1.199e-5	-6.973e-5
118	8	N7	0.07	-0.001	-0.021	-1.811e-4	-5.763e-6	-1.137e-4
119	8	N8	0.07	0	-0.021	-1.158e-4	1.157e-5	-4.224e-4
120	8	N9	0.07	-0.003	-0.021	2.245e-4	4.703e-6	1.822e-4
121	8	N10	0.07	-0.002	-0.021	-2.82e-4	-1.695e-5	1.487e-4
122	8	N11	0.07	-0.004	-0.021	5.145e-5	1.714e-5	-1.08e-4
123	8	N12	0.07	-0.003	-0.021	-1.09e-4	-4.914e-6	-7.453e-5
124	8	N13	0.071	-0.007	-0.021	2.111e-4	2.514e-5	1.739e-4
125	8	N14	0.071	-0.005	-0.021	1.242e-5	2.451e-5	-9.966e-5

Node Displacements (Continued)

	LC	Node Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
126	8	N15	0.071	-0.006	-0.021	-2.505e-4	-2.468e-5	1.571e-4
127	8	N16	0.071	-0.004	-0.021	-5.177e-5	-2.551e-5	-8.29e-5
128	9	N1	0	0	0	1.394e-3	-2.844e-5	4.865e-4
129	9	N2	0	0	0	1.404e-3	3.013e-5	3.863e-4
130	9	N3	0	0	0	1.467e-3	2.867e-5	3.143e-4
131	9	N4	0	0	0	1.476e-3	-3.052e-5	5.587e-4
132	9	N5	-0.021	0	0.069	3.322e-4	-2.844e-5	-2.267e-5
133	9	N6	-0.021	0	0.069	3.126e-4	3.013e-5	1.835e-4
134	9	N7	-0.021	-0.001	0.069	1.845e-4	2.867e-5	3.3e-4
135	9	N8	-0.021	-0.001	0.069	1.649e-4	-3.052e-5	-1.692e-4
136	9	N9	-0.021	-0.002	0.07	2.366e-4	1.701e-5	6.14e-5
137	9	N10	-0.021	-0.005	0.07	-4.49e-5	2.375e-5	1.731e-4
138	9	N11	-0.021	-0.001	0.07	2.886e-4	-2.358e-5	-8.366e-5
139	9	N12	-0.021	-0.005	0.07	-9.682e-5	-1.721e-5	-1.954e-4
140	9	N13	-0.021	-0.004	0.07	1.672e-4	-8.884e-6	8.933e-5
141	9	N14	-0.021	-0.005	0.07	2.268e-4	-6.365e-6	-1.116e-4
142	9	N15	-0.021	-0.006	0.07	-3.607e-5	6.186e-6	1.452e-4
143	9	N16	-0.021	-0.007	0.07	-9.569e-5	8.516e-6	-1.674e-4
144	10	N1	0	0	0	4.273e-4	-1.166e-5	-1.418e-3
145	10	N2	0	0	0	3.951e-4	5.844e-6	-1.482e-3
146	10	N3	0	0	0	4.634e-4	1.19e-5	-1.504e-3
147	10	N4	0	0	0	4.312e-4	-5.923e-6	-1.396e-3
148	10	N5	0.07	0	0.021	7.866e-5	-1.166e-5	-3.333e-4
149	10	N6	0.07	0	0.021	1.439e-4	5.844e-6	-2.009e-4
150	10	N7	0.07	-0.001	0.021	4.793e-6	1.19e-5	-1.57e-4
151	10	N8	0.07	0	0.021	7.002e-5	-5.923e-6	-3.772e-4
152	10	N9	0.07	-0.001	0.021	1.986e-4	1.7e-5	8.437e-5
153	10	N10	0.07	-0.002	0.021	-1.412e-4	-4.754e-6	1.179e-4
154	10	N11	0.07	-0.002	0.021	2.552e-5	4.863e-6	-1.053e-5
155	10	N12	0.07	-0.003	0.021	3.183e-5	-1.709e-5	-4.4e-5
156	10	N13	0.07	-0.003	0.021	1.847e-4	2.47e-5	9.274e-5
157	10	N14	0.07	-0.001	0.021	-1.398e-5	2.548e-5	-1.89e-5
158	10	N15	0.07	-0.004	0.021	-1.454e-4	-2.516e-5	1.095e-4
159	10	N16	0.07	-0.002	0.021	5.329e-5	-2.448e-5	-3.564e-5
160	11	N1	0	0	0	1.418e-3	-3.021e-5	-4.279e-4
161	11	N2	0	0	0	1.408e-3	2.853e-5	-4.421e-4
162	11	N3	0	0	0	1.454e-3	3.044e-5	-5.142e-4
163	11	N4	0	0	0	1.444e-3	-2.858e-5	-3.561e-4
164	11	N5	0.021	0	0.069	2.75e-4	-3.021e-5	-9.509e-5
165	11	N6	0.021	0	0.069	2.945e-4	2.853e-5	-6.513e-5
166	11	N7	0.021	-0.001	0.069	2.011e-4	3.044e-5	8.123e-5
167	11	N8	0.021	0	0.069	2.207e-4	-2.858e-5	-2.415e-4
168	11	N9	0.021	0	0.069	2.049e-4	2.363e-5	1.947e-5
169	11	N10	0.021	-0.003	0.069	-1.374e-5	1.716e-5	1.311e-4
170	11	N11	0.021	0	0.069	1.53e-4	-1.706e-5	2.679e-6
171	11	N12	0.021	-0.003	0.069	3.818e-5	-2.37e-5	-1.089e-4
172	11	N13	0.021	-0.002	0.069	1.61e-4	6.389e-6	4.737e-5
173	11	N14	0.021	-0.001	0.069	1.014e-4	8.857e-6	-2.522e-5
174	11	N15	0.021	-0.004	0.069	-3.003e-5	-8.542e-6	1.032e-4
175	11	N16	0.021	-0.003	0.069	2.959e-5	-6.162e-6	-8.101e-5
176	12	N1	0	0	0	-4.312e-4	5.923e-6	-1.396e-3
177	12	N2	0	0	0	-4.634e-4	-1.19e-5	-1.504e-3
178	12	N3	0	0	0	-3.951e-4	-5.844e-6	-1.482e-3
179	12	N4	0	0	0	-4.273e-4	1.166e-5	-1.418e-3
180	12	N5	0.07	0	-0.021	-7.002e-5	5.923e-6	-3.772e-4
181	12	N6	0.07	-0.001	-0.021	-4.793e-6	-1.19e-5	-1.57e-4
182	12	N7	0.07	0	-0.021	-1.439e-4	-5.844e-6	-2.009e-4
183	12	N8	0.07	0	-0.021	-7.866e-5	1.166e-5	-3.333e-4
184	12	N9	0.07	-0.002	-0.021	1.412e-4	4.754e-6	1.179e-4
185	12	N10	0.07	-0.001	-0.021	-1.986e-4	-1.7e-5	8.437e-5
186	12	N11	0.07	-0.003	-0.021	-3.183e-5	1.709e-5	-4.4e-5
187	12	N12	0.07	-0.002	-0.021	-2.552e-5	-4.863e-6	-1.053e-5
188	12	N13	0.07	-0.004	-0.021	1.454e-4	2.516e-5	1.095e-4

Node Displacements (Continued)

	LC	Node Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
189	12	N14	0.07	-0.002	-0.021	-5.329e-5	2.448e-5	-3.564e-5
190	12	N15	0.07	-0.003	-0.021	-1.847e-4	-2.47e-5	9.274e-5
191	12	N16	0.07	-0.001	-0.021	1.398e-5	-2.548e-5	-1.89e-5
192	13	N1	0	0	0	1.408e-3	-2.853e-5	4.421e-4
193	13	N2	0	0	0	1.418e-3	3.021e-5	4.279e-4
194	13	N3	0	0	0	1.444e-3	2.858e-5	3.561e-4
195	13	N4	0	0	0	1.454e-3	-3.044e-5	5.142e-4
196	13	N5	-0.021	0	0.069	2.945e-4	-2.853e-5	6.513e-5
197	13	N6	-0.021	0	0.069	2.75e-4	3.021e-5	9.509e-5
198	13	N7	-0.021	0	0.069	2.207e-4	2.858e-5	2.415e-4
199	13	N8	-0.021	-0.001	0.069	2.011e-4	-3.044e-5	-8.123e-5
200	13	N9	-0.021	0	0.069	1.53e-4	1.706e-5	-2.679e-6
201	13	N10	-0.021	-0.003	0.069	3.818e-5	2.37e-5	1.089e-4
202	13	N11	-0.021	0	0.069	2.049e-4	-2.363e-5	-1.947e-5
203	13	N12	-0.021	-0.003	0.069	-1.374e-5	-1.716e-5	-1.311e-4
204	13	N13	-0.021	-0.001	0.069	1.014e-4	-8.857e-6	2.522e-5
205	13	N14	-0.021	-0.002	0.069	1.61e-4	-6.389e-6	-4.737e-5
206	13	N15	-0.021	-0.003	0.069	2.959e-5	6.162e-6	8.101e-5
207	13	N16	-0.021	-0.004	0.069	-3.003e-5	8.542e-6	-1.032e-4
208	14*	N1	0	0	0	4.106e-4	-1.157e-5	-1.379e-3
209	14*	N2	0	0	0	3.784e-4	5.763e-6	-1.53e-3
210	14*	N3	0	0	0	4.828e-4	1.199e-5	-1.552e-3
211	14*	N4	0	0	0	4.506e-4	-6.005e-6	-1.358e-3
212	14*	N5	0.07	0	0.021	1.158e-4	-1.157e-5	-4.224e-4
213	14*	N6	0.07	-0.001	0.021	1.811e-4	5.763e-6	-1.137e-4
214	14*	N7	0.07	-0.001	0.021	-3.192e-5	1.199e-5	-6.973e-5
215	14*	N8	0.07	0	0.021	3.33e-5	-6.005e-6	-4.664e-4
216	14*	N9	0.07	-0.002	0.021	2.82e-4	1.695e-5	1.487e-4
217	14*	N10	0.07	-0.003	0.021	-2.245e-4	-4.703e-6	1.822e-4
218	14*	N11	0.07	-0.003	0.021	1.09e-4	4.914e-6	-7.453e-5
219	14*	N12	0.07	-0.004	0.021	-5.145e-5	-1.714e-5	-1.08e-4
220	14*	N13	0.071	-0.006	0.021	2.505e-4	2.468e-5	1.571e-4
221	14*	N14	0.071	-0.004	0.021	5.177e-5	2.551e-5	-8.29e-5
222	14*	N15	0.071	-0.007	0.021	-2.111e-4	-2.514e-5	1.739e-4
223	14*	N16	0.071	-0.005	0.021	-1.242e-5	-2.451e-5	-9.966e-5
224	15*	N1	0	0	0	1.404e-3	-3.013e-5	-3.863e-4
225	15*	N2	0	0	0	1.394e-3	2.844e-5	-4.865e-4
226	15*	N3	0	0	0	1.476e-3	3.052e-5	-5.587e-4
227	15*	N4	0	0	0	1.467e-3	-2.867e-5	-3.143e-4
228	15*	N5	0.021	0	0.069	3.126e-4	-3.013e-5	-1.835e-4
229	15*	N6	0.021	0	0.069	3.322e-4	2.844e-5	2.267e-5
230	15*	N7	0.021	-0.001	0.069	1.649e-4	3.052e-5	1.692e-4
231	15*	N8	0.021	-0.001	0.069	1.845e-4	-2.867e-5	-3.3e-4
232	15*	N9	0.021	-0.001	0.07	2.886e-4	2.358e-5	8.366e-5
233	15*	N10	0.021	-0.005	0.07	-9.682e-5	1.721e-5	1.954e-4
234	15*	N11	0.021	-0.002	0.07	2.366e-4	-1.701e-5	-6.14e-5
235	15*	N12	0.021	-0.005	0.07	-4.49e-5	-2.375e-5	-1.731e-4
236	15*	N13	0.021	-0.005	0.07	2.268e-4	6.365e-6	1.116e-4
237	15*	N14	0.021	-0.004	0.07	1.672e-4	8.884e-6	-8.933e-5
238	15*	N15	0.021	-0.007	0.07	-9.569e-5	-8.516e-6	1.674e-4
239	15*	N16	0.021	-0.006	0.07	-3.607e-5	-6.186e-6	-1.452e-4
240	16*	N1	0	0	0	-4.506e-4	6.005e-6	-1.358e-3
241	16*	N2	0	0	0	-4.828e-4	-1.199e-5	-1.552e-3
242	16*	N3	0	0	0	-3.784e-4	-5.763e-6	-1.53e-3
243	16*	N4	0	0	0	-4.106e-4	1.157e-5	-1.379e-3
244	16*	N5	0.07	0	-0.021	-3.33e-5	6.005e-6	-4.664e-4
245	16*	N6	0.07	-0.001	-0.021	3.192e-5	-1.199e-5	-6.973e-5
246	16*	N7	0.07	-0.001	-0.021	-1.811e-4	-5.763e-6	-1.137e-4
247	16*	N8	0.07	0	-0.021	-1.158e-4	1.157e-5	-4.224e-4
248	16*	N9	0.07	-0.003	-0.021	2.245e-4	4.703e-6	1.822e-4
249	16*	N10	0.07	-0.002	-0.021	-2.82e-4	-1.695e-5	1.487e-4
250	16*	N11	0.07	-0.004	-0.021	5.145e-5	1.714e-5	-1.08e-4
251	16*	N12	0.07	-0.003	-0.021	-1.09e-4	-4.914e-6	-7.453e-5

Node Displacements (Continued)

	LC	Node Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
252	16*	N13	0.071	-0.007	-0.021	2.111e-4	2.514e-5	1.739e-4
253	16*	N14	0.071	-0.005	-0.021	1.242e-5	2.451e-5	-9.966e-5
254	16*	N15	0.071	-0.006	-0.021	-2.505e-4	-2.468e-5	1.571e-4
255	16*	N16	0.071	-0.004	-0.021	-5.177e-5	-2.551e-5	-8.29e-5
256	17*	N1	0	0	0	1.394e-3	-2.844e-5	4.865e-4
257	17*	N2	0	0	0	1.404e-3	3.013e-5	3.863e-4
258	17*	N3	0	0	0	1.467e-3	2.867e-5	3.143e-4
259	17*	N4	0	0	0	1.476e-3	-3.052e-5	5.587e-4
260	17*	N5	-0.021	0	0.069	3.322e-4	-2.844e-5	-2.267e-5
261	17*	N6	-0.021	0	0.069	3.126e-4	3.013e-5	1.835e-4
262	17*	N7	-0.021	-0.001	0.069	1.845e-4	2.867e-5	3.3e-4
263	17*	N8	-0.021	-0.001	0.069	1.649e-4	-3.052e-5	-1.692e-4
264	17*	N9	-0.021	-0.002	0.07	2.366e-4	1.701e-5	6.14e-5
265	17*	N10	-0.021	-0.005	0.07	-4.49e-5	2.375e-5	1.731e-4
266	17*	N11	-0.021	-0.001	0.07	2.886e-4	-2.358e-5	-8.366e-5
267	17*	N12	-0.021	-0.005	0.07	-9.682e-5	-1.721e-5	-1.954e-4
268	17*	N13	-0.021	-0.004	0.07	1.672e-4	-8.884e-6	8.933e-5
269	17*	N14	-0.021	-0.005	0.07	2.268e-4	-6.365e-6	-1.116e-4
270	17*	N15	-0.021	-0.006	0.07	-3.607e-5	6.186e-6	1.452e-4
271	17*	N16	-0.021	-0.007	0.07	-9.569e-5	8.516e-6	-1.674e-4
272	18*	N1	0	0	0	4.273e-4	-1.166e-5	-1.418e-3
273	18*	N2	0	0	0	3.951e-4	5.844e-6	-1.482e-3
274	18*	N3	0	0	0	4.634e-4	1.19e-5	-1.504e-3
275	18*	N4	0	0	0	4.312e-4	-5.923e-6	-1.396e-3
276	18*	N5	0.07	0	0.021	7.866e-5	-1.166e-5	-3.333e-4
277	18*	N6	0.07	0	0.021	1.439e-4	5.844e-6	-2.009e-4
278	18*	N7	0.07	-0.001	0.021	4.793e-6	1.19e-5	-1.57e-4
279	18*	N8	0.07	0	0.021	7.002e-5	-5.923e-6	-3.772e-4
280	18*	N9	0.07	-0.001	0.021	1.986e-4	1.7e-5	8.437e-5
281	18*	N10	0.07	-0.002	0.021	-1.412e-4	-4.754e-6	1.179e-4
282	18*	N11	0.07	-0.002	0.021	2.552e-5	4.863e-6	-1.053e-5
283	18*	N12	0.07	-0.003	0.021	3.183e-5	-1.709e-5	-4.4e-5
284	18*	N13	0.07	-0.003	0.021	1.847e-4	2.47e-5	9.274e-5
285	18*	N14	0.07	-0.001	0.021	-1.398e-5	2.548e-5	-1.89e-5
286	18*	N15	0.07	-0.004	0.021	-1.454e-4	-2.516e-5	1.095e-4
287	18*	N16	0.07	-0.002	0.021	5.329e-5	-2.448e-5	-3.564e-5
288	19*	N1	0	0	0	1.418e-3	-3.021e-5	-4.279e-4
289	19*	N2	0	0	0	1.408e-3	2.853e-5	-4.421e-4
290	19*	N3	0	0	0	1.454e-3	3.044e-5	-5.142e-4
291	19*	N4	0	0	0	1.444e-3	-2.858e-5	-3.561e-4
292	19*	N5	0.021	0	0.069	2.75e-4	-3.021e-5	-9.509e-5
293	19*	N6	0.021	0	0.069	2.945e-4	2.853e-5	-6.513e-5
294	19*	N7	0.021	-0.001	0.069	2.011e-4	3.044e-5	8.123e-5
295	19*	N8	0.021	0	0.069	2.207e-4	-2.858e-5	-2.415e-4
296	19*	N9	0.021	0	0.069	2.049e-4	2.363e-5	1.947e-5
297	19*	N10	0.021	-0.003	0.069	-1.374e-5	1.716e-5	1.311e-4
298	19*	N11	0.021	0	0.069	1.53e-4	-1.706e-5	2.679e-6
299	19*	N12	0.021	-0.003	0.069	3.818e-5	-2.37e-5	-1.089e-4
300	19*	N13	0.021	-0.002	0.069	1.61e-4	6.389e-6	4.737e-5
301	19*	N14	0.021	-0.001	0.069	1.014e-4	8.857e-6	-2.522e-5
302	19*	N15	0.021	-0.004	0.069	-3.003e-5	-8.542e-6	1.032e-4
303	19*	N16	0.021	-0.003	0.069	2.959e-5	-6.162e-6	-8.101e-5
304	20*	N1	0	0	0	-4.312e-4	5.923e-6	-1.396e-3
305	20*	N2	0	0	0	-4.634e-4	-1.19e-5	-1.504e-3
306	20*	N3	0	0	0	-3.951e-4	-5.844e-6	-1.482e-3
307	20*	N4	0	0	0	-4.273e-4	1.166e-5	-1.418e-3
308	20*	N5	0.07	0	-0.021	-7.002e-5	5.923e-6	-3.772e-4
309	20*	N6	0.07	-0.001	-0.021	-4.793e-6	-1.19e-5	-1.57e-4
310	20*	N7	0.07	0	-0.021	-1.439e-4	-5.844e-6	-2.009e-4
311	20*	N8	0.07	0	-0.021	-7.866e-5	1.166e-5	-3.333e-4
312	20*	N9	0.07	-0.002	-0.021	1.412e-4	4.754e-6	1.179e-4
313	20*	N10	0.07	-0.001	-0.021	-1.986e-4	-1.7e-5	8.437e-5
314	20*	N11	0.07	-0.003	-0.021	-3.183e-5	1.709e-5	-4.4e-5

Node Displacements (Continued)

	LC	Node Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
315	20*	N12	0.07	-0.002	-0.021	-2.552e-5	-4.863e-6	-1.053e-5
316	20*	N13	0.07	-0.004	-0.021	1.454e-4	2.516e-5	1.095e-4
317	20*	N14	0.07	-0.002	-0.021	-5.329e-5	2.448e-5	-3.564e-5
318	20*	N15	0.07	-0.003	-0.021	-1.847e-4	-2.47e-5	9.274e-5
319	20*	N16	0.07	-0.001	-0.021	1.398e-5	-2.548e-5	-1.89e-5
320	21*	N1	0	0	0	1.408e-3	-2.853e-5	4.421e-4
321	21*	N2	0	0	0	1.418e-3	3.021e-5	4.279e-4
322	21*	N3	0	0	0	1.444e-3	2.858e-5	3.561e-4
323	21*	N4	0	0	0	1.454e-3	-3.044e-5	5.142e-4
324	21*	N5	-0.021	0	0.069	2.945e-4	-2.853e-5	6.513e-5
325	21*	N6	-0.021	0	0.069	2.75e-4	3.021e-5	9.509e-5
326	21*	N7	-0.021	0	0.069	2.207e-4	2.858e-5	2.415e-4
327	21*	N8	-0.021	-0.001	0.069	2.011e-4	-3.044e-5	-8.123e-5
328	21*	N9	-0.021	0	0.069	1.53e-4	1.706e-5	-2.679e-6
329	21*	N10	-0.021	-0.003	0.069	3.818e-5	2.37e-5	1.089e-4
330	21*	N11	-0.021	0	0.069	2.049e-4	-2.363e-5	-1.947e-5
331	21*	N12	-0.021	-0.003	0.069	-1.374e-5	-1.716e-5	-1.311e-4
332	21*	N13	-0.021	-0.001	0.069	1.014e-4	-8.857e-6	2.522e-5
333	21*	N14	-0.021	-0.002	0.069	1.61e-4	-6.389e-6	-4.737e-5
334	21*	N15	-0.021	-0.003	0.069	2.959e-5	6.162e-6	8.101e-5
335	21*	N16	-0.021	-0.004	0.069	-3.003e-5	8.542e-6	-1.032e-4

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N1	max	42.261	9	405.766	4	34.621	8	0	13	0	13	0	13
1		min	-90.642	10	-285.931	10	-95.46	11	0	1	0	1	0	1
2	N2	max	27.811	13	895.673	8	42.341	8	0	13	0	13	0	13
3		min	-121.705	8	-285.748	13	-95.46	13	0	1	0	1	0	1
4	N3	max	9.293	13	895.673	6	20.652	12	0	13	0	13	0	13
5		min	-121.705	6	0	2	-107.534	7	0	1	0	1	0	1
6	N4	max	60.047	9	895.48	9	29.124	12	0	13	0	13	0	13
7		min	-90.642	12	-285.931	12	-107.534	9	0	1	0	1	0	1
8	Totals:	max	117.6	13	1623.063	8	117.6	12						
9		min	-392	10	0	2	-392	11						

Envelope Node Reactions - Overstrength or Capacity Limit

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N1	max	42.261	17*	142.197	17*	34.621	16*	0	21*	0	21*	0	21*
1		min	-90.642	18*	-285.931	18*	-95.46	19*	0	14*	0	14*	0	14*
2	N2	max	27.811	21*	895.673	16*	42.341	16*	0	21*	0	21*	0	21*
3		min	-121.705	16*	-285.748	21*	-95.46	21*	0	14*	0	14*	0	14*
4	N3	max	9.293	21*	895.673	14*	20.652	20*	0	21*	0	21*	0	21*
5		min	-121.705	14*	465.867	21*	-107.534	15*	0	14*	0	14*	0	14*
6	N4	max	60.047	17*	895.48	17*	29.124	20*	0	21*	0	21*	0	21*
7		min	-90.642	20*	-285.931	20*	-107.534	17*	0	14*	0	14*	0	14*
8	Totals:	max	117.6	21*	1623.063	16*	117.6	20*						
9		min	-392	18*	811.531	19*	-392	19*						

Envelope AISC 15TH (360-16): ASD Member Steel Code Checks

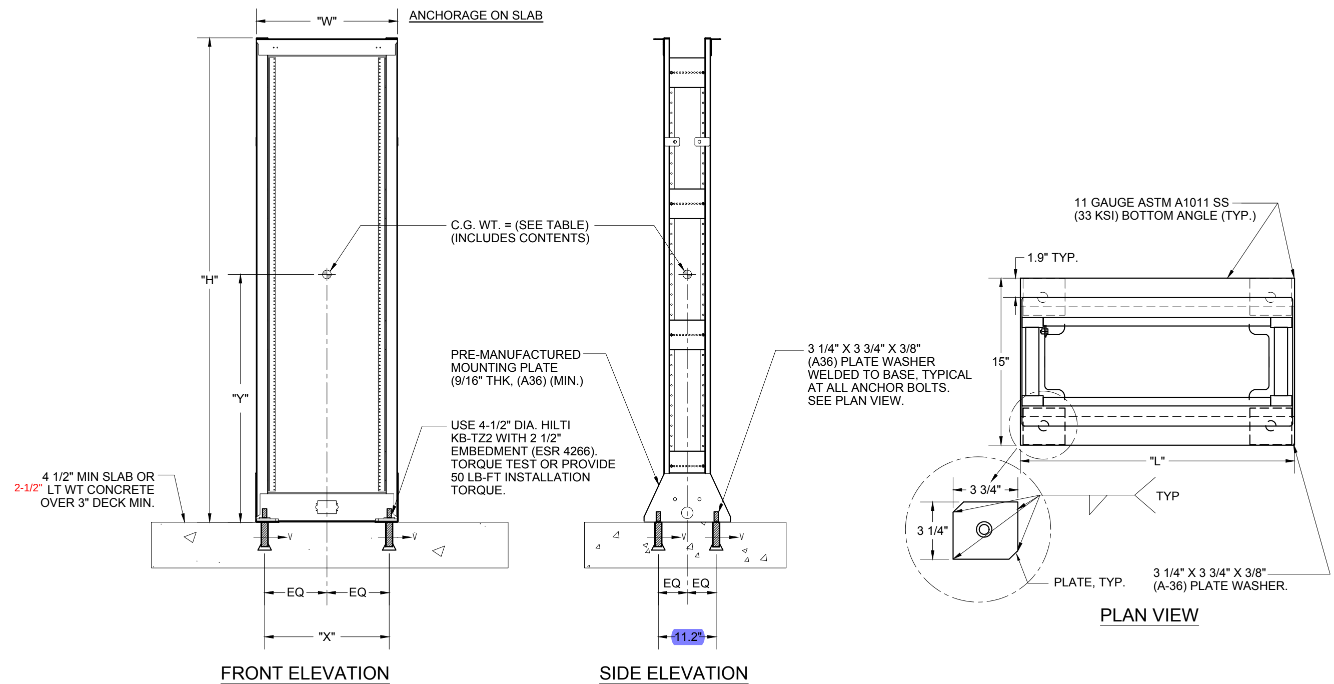
	Member	Shape	Code Check	Loc[in]	LC	Shear Check	Loc[in]	Dir	LC	Pnc/om [lb]	Pnt/om [lb]	Mnyy/om [k-ft]	Mnzz/om [k-ft]	Cb	Eqn
0	M1	HSS4X4X4	0.066	0	8	0.044	0	y	8	86814.092	92826.347	10.765	10.765	2.307	H1-1b
1	M2	HSS4X4X4	0.047	0	9	0.014	48	y	7	86814.092	92826.347	10.765	10.765	2.129	H1-1b
2	M3	HSS4X4X4	0.066	48	6	0.045	0	y	9	86814.092	92826.347	10.765	10.765	2.307	H1-1b
3	M4	HSS4X4X4	0.047	48	7	0.014	0	y	9	86814.092	92826.347	10.765	10.765	2.129	H1-1b
4	M5	HSS4X4X4	0.09	66	8	0.005	66	y	8	81788.064	92826.347	10.765	10.765	1.667	H1-1b
5	M6	HSS4X4X4	0.067	66	9	0.004	66	z	11	81788.064	92826.347	10.765	10.765	1.667	H1-1b
6	M7	HSS4X4X4	0.091	66	7	0.005	66	y	6	81788.064	92826.347	10.765	10.765	1.667	H1-1b
7	M8	HSS4X4X4	0.091	66	9	0.004	66	z	9	81788.064	92826.347	10.765	10.765	1.667	H1-1b
8	M9	HSS4X4X4	0.032	48	6	0.023	0	y	8	86814.092	92826.347	10.765	10.765	1.029	H1-1b

Envelope AISC 15TH (360-16): ASD Member Steel Code Checks (Continued)

	Member	Shape	Code Check	Loc[in]	LC	Shear Check	Loc[in]	Dir	LC	Pnc/om [lb]	Pnt/om [lb]	Mnyy/om [k-ft]	Mnzz/om [k-ft]	Cb	Eqn
9	M10	HSS4X4X4	0.028	48	9	0.022	48	y	9	86814.092	92826.347	10.765	10.765	1.159	H1-1b

B1

Detail 1/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.

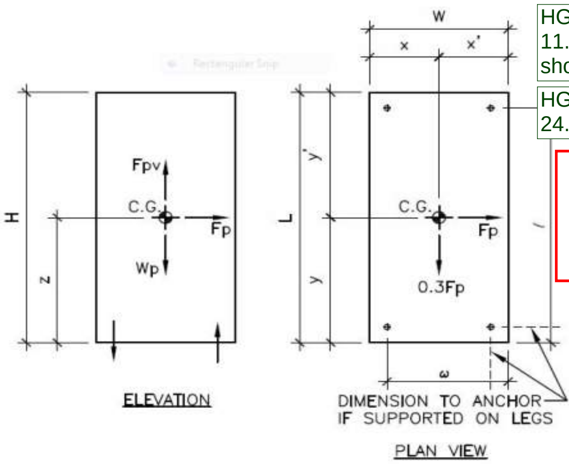
1 EQUIPMENT RACK - MOUNTED TO SLAB ON GRADE OR CONCRETE FILLED METAL DECK

NO SCALE

B1

2019 CBC & ASCE 7-16 EQUIP ANCHORAGE FORCES (LRFD) - B1

3/20/2024 B1



HGA: Anchor spacing of 11.2 used here, Half of the short dimension

HGA: The long dimension of 24.75" is input here. B1

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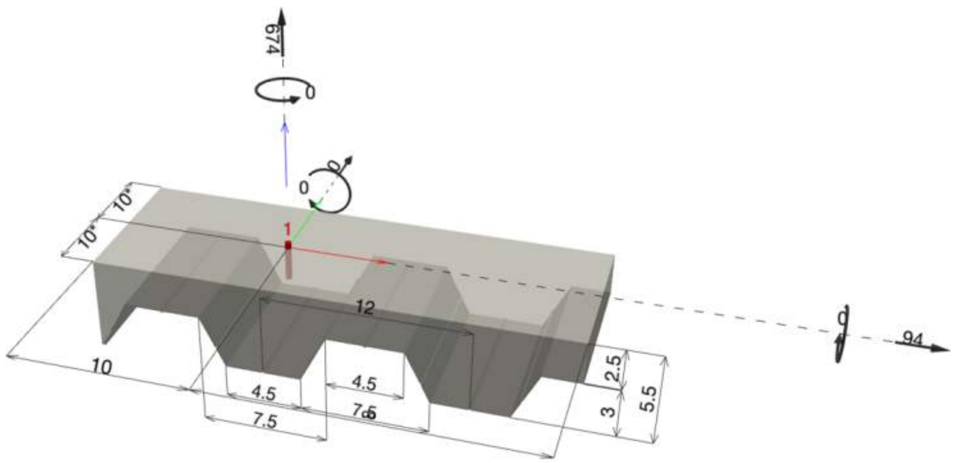
Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/9/2024
Fastening point:			

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]



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

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)

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/9/2024
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	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)

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

Company:		Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/9/2024
Fastening point:			

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

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	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)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ 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	94

Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/9/2024
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.]
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

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

Company:		Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/9/2024
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 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

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

Commission No: 1500-163-01
UCD EB Net V2
ENGR: ZL
January 2024
3/20/2024 B1

Detail 1/E7.09

Vertiv UPS 12HX205

UPS OPT WEIGHT =1032+684= 1716#

NOT PART of life safety or emergency systems

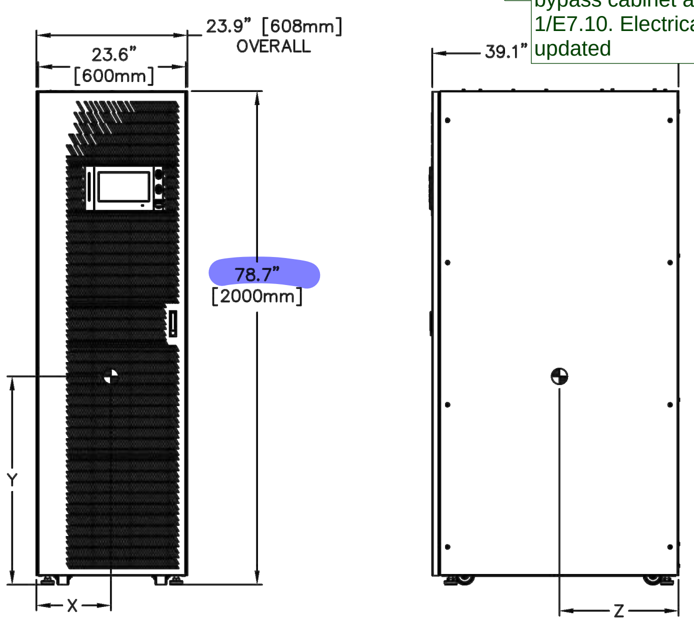
INTERNAL BATTERY STRING		
BATT PN	LBS	KG
12HX100	528	240
12HX150E	624	283
12HX205	1,032	468
HR1500	648	294
HR2000	960	435
HRL12110	524	238
HRL12150	622	282
HRL12200	931	422

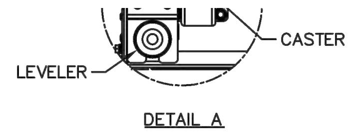
THIS CHART APPLIES ONLY TO THE 10-40kVA MODELS.

kVA RATING	UPS HEAT DISSIPATION AT FULL LOAD (BTU/HR)	WEIGH 40kVA FRAME
10	2,217	684 (320)
15	3,245	684 (320)
20	3,843	684 (320)

HGA: Electrical Schedule shows weight includes a 200 mm UPS bypass cabinet as shown in detail 1/E7.10. Electrical schedule updated

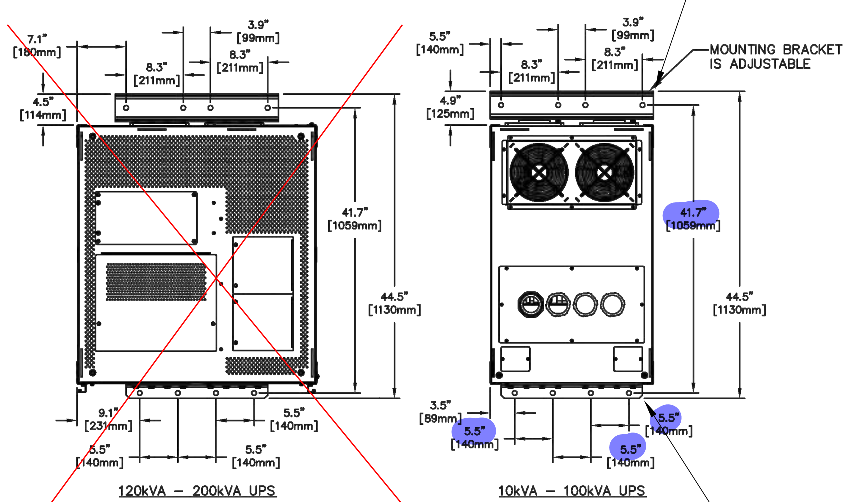
B1





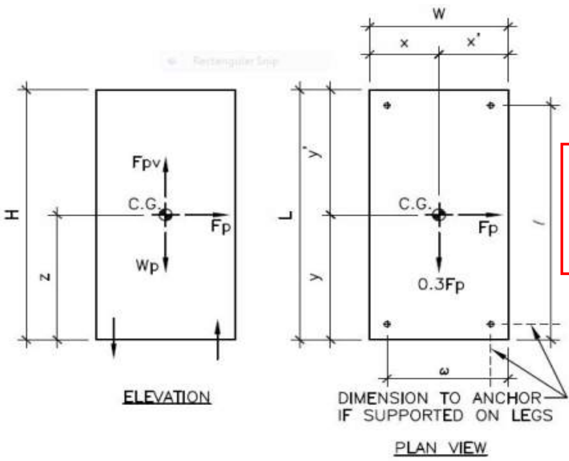
UPS kVA RATING	CENTER OF GRAVITY in(mm)		
	X	Y	Z
10 – 20	11.8"(300mm)	33.1"(840mm)	18.9"(480mm)
30 – 40	11.8"(300mm)	33.1"(840mm)	18.9"(480mm)

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.

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



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 = 1716 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

LESS THAN 2000#
FLR DESIGN LOAD
OK

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

L2 OF 2 STORY BUILDING

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

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 = 0.158 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 = 0.158 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 = 544 lbs

OTM = z_q * $F_{p,\Omega}$ = 17994 lb-in

F_{pv} = 170 lbs

DLRM = $(0.9W_p - F_{pv}) * x_{min}$ = 11340 lb-in

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

T = 266 lbs

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

V = 136 lbs

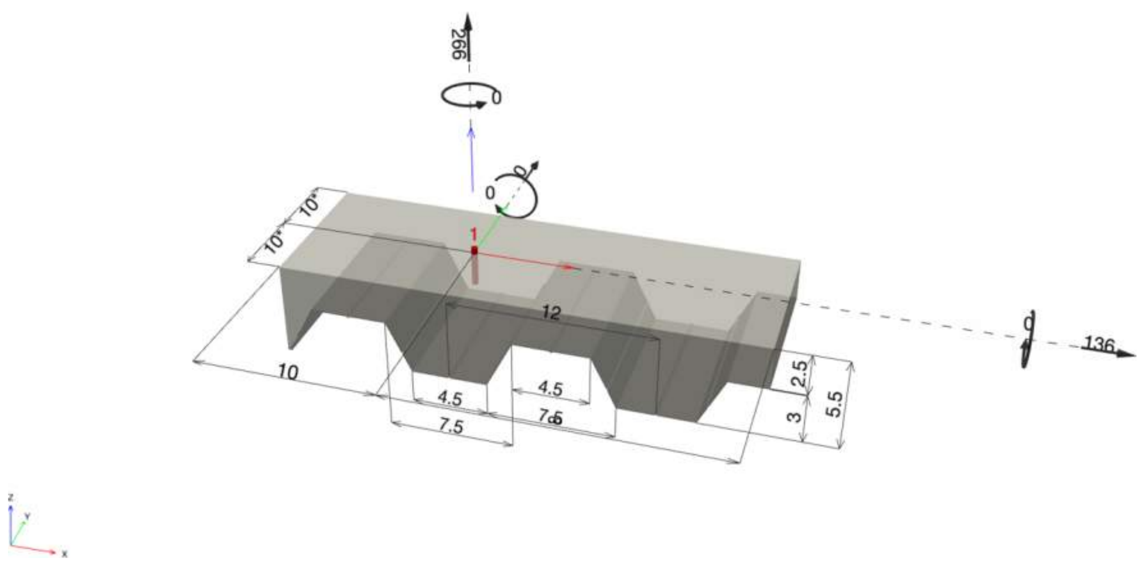
Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
Fastening point:			

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]



Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 266; V_x = 136; V_y = 0;$ $M_x = 0; M_y = 0; M_z = 0;$	yes	28

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	266	136	136	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 ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	266	4,869	6	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	266	952	28	OK

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

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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	266

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	266

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	136	2,201	7	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	136	1,366	10	OK
Concrete edge failure in direction y-**	136	2,965	5	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	136

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ 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	136

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	136

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.280	0.100	5/3	15	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:	1/10/2024
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.

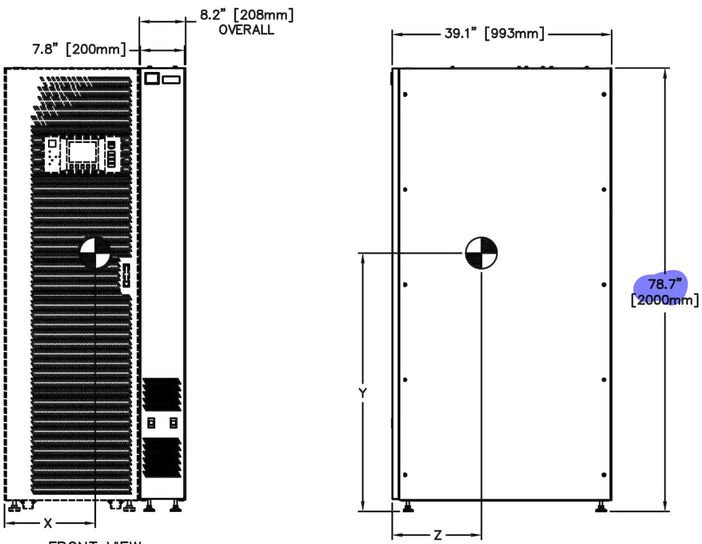
Detail 1/E7.10

Vertiv UPS BYPASS Cabinet 200 mm

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

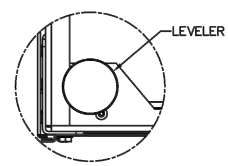
NOT PART of life safety or emergency systems

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



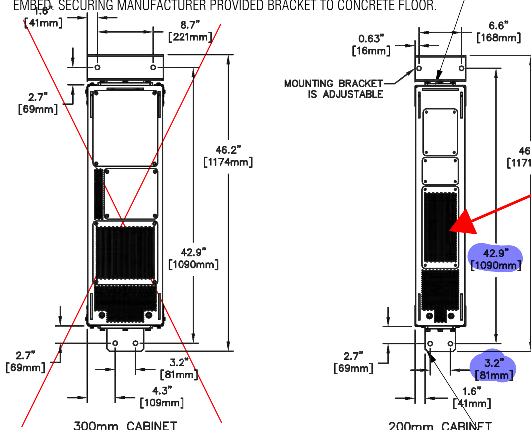
FRONT VIEW
(UPS SHOWN FOR REFERENCE ONLY)

RIGHT SIDE VIEW



DETAIL A

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



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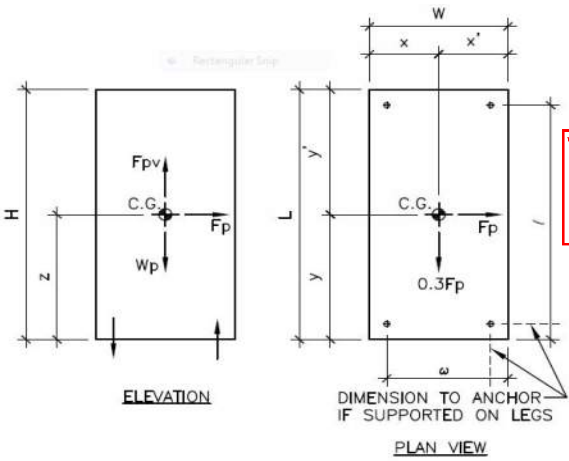
TYPICAL- (2) 3/8" HILTI KB-TZ2 EXPANSION ANCHORS WITH 2-1/2" MINIMUM EMBED. SECURING MANUFACTURER PROVIDED BRACKET TO CONCRETE FLOOR.

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



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 = 1.00 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 = 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} = 0.495

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 = 0.158 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 = 0.158 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 = 76 lbs
OTM = z_q * $F_{p,\Omega}$ = 3497 lb-in
F_{pv} = 24 lbs
DLRM = $(0.9W_p - F_{pv}) * x_{min}$ = 308 lb-in

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

T = 511 lbs

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

V = 19 lbs

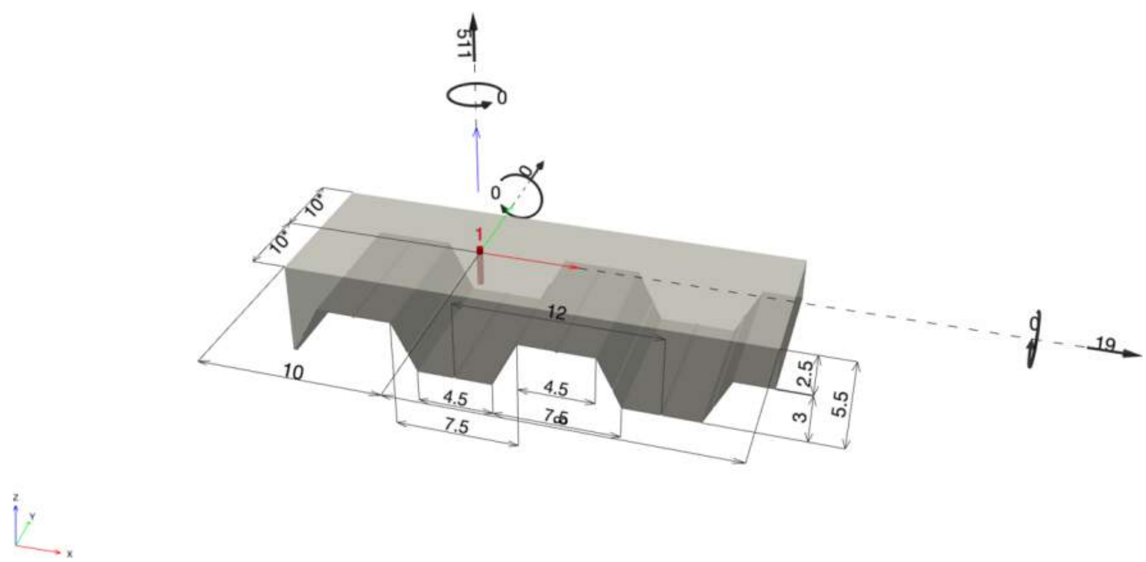
Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
Fastening point:			

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]



Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 511; V_x = 19; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	54

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	511	19	19	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*	511	4,869	11	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	511	952	54	OK

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

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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	511

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	511

Company:		Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity $\phi\ V_n$ [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	19	2,201	1	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	19	1,366	2	OK
Concrete edge failure in direction y-**	19	2,965	1	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	19

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0$ 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	19

Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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.]
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	19

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.537	0.014	5/3	36	OK

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

Company:		Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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!

Company:		Page:	8
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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

Company:		Page:	9
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Metal deck - Jan 2, 2024	Date:	1/10/2024
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.