23 Mauchly, #110, Irvine, CA 92618

Structural Analysis (Equip Anchorage)

December 26, 2023

Site: BA00324A, "SF324 Meadow Park School"
Type: Rooftop
Address: 5400 Nave Dr., Novato, CA 94949
County: Marin County
Lat/Long: 38° 3' 2.0" N, 122° 31' 49.7" W (38.050544, -122.530467)
P#/Eng: P-095412/AN

DATE: 12/26/2023
EXPIRES: 09/30/2025

J5 Infrastructure Partners (J5IP) is pleased to submit this structural analysis report to T-Mobile. The purpose of this analysis is to design anchorage for proposed cabinets. The project scope of work relevant to this report includes the following items:

- Remove (1) (E) BTS 6102 Cabinet
- Remove (1) (E) BTS 2102 Cabinet
- Install (1) (P) Ericsson 6160 Cabinet
- Install (1) (P) Ericsson B160 Cabient

A site visit was performed by J5IP personnel on June 13, 2019. Existing elements relevant to the project scope of work were visually inspected and found to be in good condition.

This report was prepared in accordance with the 2022 CBC, ASCE 7-16, ACI 318-19, and the AISC 360-16.

This analysis is based off third party data and assumes satisfactory workmanship of all previously-installed and proposed components. If existing conditions vary from what is shown in this report, or if assumptions made within this analysis are inaccurate, the Engineer of Record shall be notified immediately in writing.

It has been our pleasure to be of service to you in this matter. The results of our analysis are summarized in the table below. Please contact us should you have any specific questions, require further clarification, or if we can be of further service.

Sincerely,
J5 Infrastructure Partners, Inc.

Description of Element	Demand-Capacity Ratio	Result	Notes
(P) Cabinet Anchorage (1/2" KB-TZ2 w/ 2.5" Nominal Embed.)	37%	PASS	

Due Diligence Review

This report is based on the information obtained in the documents listed below.

Documents Summary

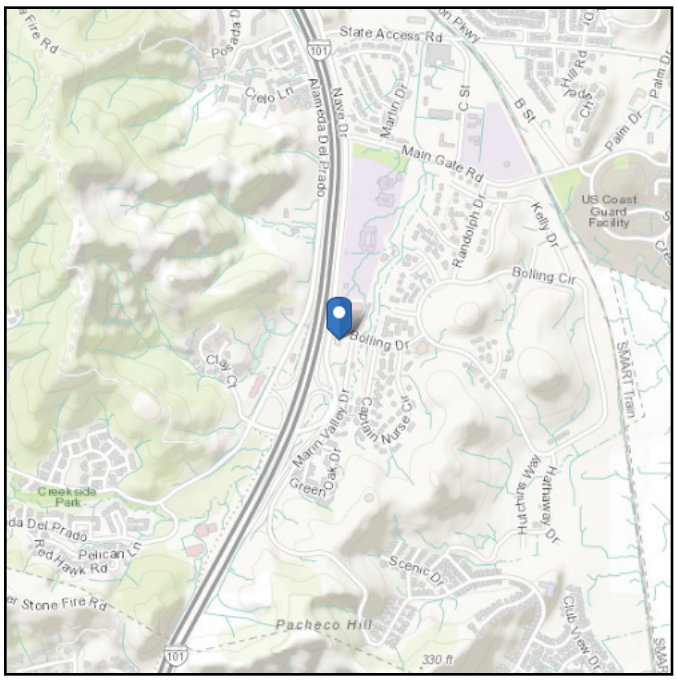
No.	Document Type	Firm	Date	Information Obtained
1	Site Visit Photos	Centerline	Jul 10, 2023	Site Photos
2	As-Built Drawings	ZON Architects	Dec 30, 2015	(E) Equipment Anchorage (Assume 6" Pad)
3	Structural Analysis	ZON Architects	Nov 5, 2015	(E) Antenna Mount Framing Analysis (E) Roof Framing Check

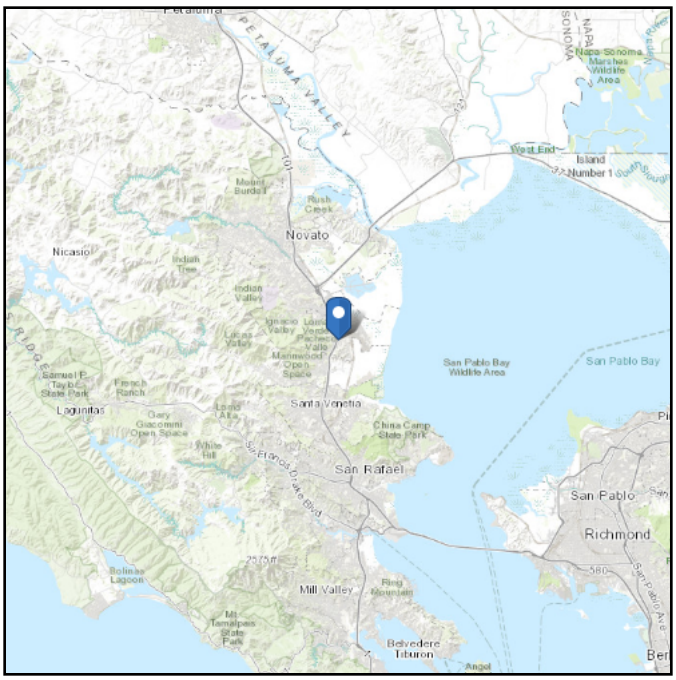
ASCE 7 Hazards Report

Address:
5400 Nave Dr
Novato, California
94949

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Default (see Section 11.4.3)

Latitude: 38.050669
Longitude: -122.530488
Elevation: 79.7455980899168 ft (NAVD 88)





Wind

Results:

Wind Speed	92 Vmph
10-year MRI	64 Vmph
25-year MRI	70 Vmph
50-year MRI	74 Vmph
100-year MRI	79 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Fri Dec 15 2023

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.5	S_{D1} :	N/A
S_1 :	0.6	T_L :	12
F_a :	1.2	PGA :	0.583
F_v :	N/A	PGA_M :	0.7
S_{MS} :	1.8	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.2	C_v :	1.4

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Fri Dec 15 2023

Date Source: USGS Seismic Design Maps

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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Project: **BA00324A**
Engineer: **AN**
Date: **December 26, 2023**

Seismic Design Criteria where ASCE 7-16 CH 11.4.8 Applies

The web-based tools used to determine seismic design criteria do not produce values for F_a and F_v where ASCE 7-16 CH 11.4.8 is applicable. This tool produces the missing values and determines if a site-specific ground motion study per ASCE 7-16 CH 21.1 is required.

Site Information

Risk Category:	**II**
Site Class:	**D** *(Default)*
S_S:	**1.500**
S_1:	**0.600**
F_a:	1.200
F_v:	1.700
S_{MS}:	1.800
S_{M1}:	1.020
S_{DS}:	**1.200**
S_{D1}:	**0.680**
T_L:	**12**
T_S:	0.567
T_0:	0.113

For Site Class D, Only

Is Site Class assumed? **Yes**

Seismic Design Category

Seismic Design Category: **D**

Notes regarding ASCE 7-16 CH 11.4.8

A site-specific analysis is not required for structures on Site Class D sites where $S_1 \geq 0.2$, provided the seismic response coefficient, C_s, is modified per ASCE CH 11.4.8 Exception 2. There are no additional requirements for non-structural components designed per ASCE CH 13.

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Equipment Anchorage Forces

- Determine maximum anchor forces for equipment due to wind and/or seismic forces.
- Seismic coefficients are per ASCE 7-16 CH 13.3
- Wind pressures are per ASCE 7-16 CH 29.4.1
- Assumes rectangular 4-anchor layout

Unit Information

Name: **(N) Ericsson 6160 Cabinet**

W_p:	**465**	lb	*(Component operating weight)*				
W:	**26.0**	in	*(Equipment width)*	A:	**20.0**	in	*(Bolt spacing)*
D:	**26.0**	in	*(Equipment depth)*	B:	**20.0**	in	*(Bolt spacing)*
H:	**63.0**	in	*(Equipment height)*	C:	**31.5**	in	*(Height to center of gravity)*

Seismic Coefficients

S_{DS}:	**1.200**	g	a_p:	**1.00**	F_p: $0.36W_p$ = 167 lb		*(Per Section 13.3.1)*
z/h:	**0.0**	ft/ft	R_p:	**2.50**	F_{pv}: $0.24W_p$ = 112 lb		*(Per Section 13.3.2)*
I_p:	**1.00**		Ω_o:	**2.00**			

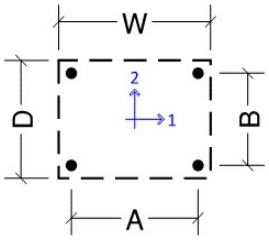
Wind Pressures

Unit is exposed to wind

Exposure:	**C**		q_h:	$0.00256K_zK_{zt}K_dK_eV^2$
V:	**92**	mph	*(Basic wind speed)*	q_h: $0.00256(0.85)(1.00)(0.85)(1.00)(92)^2$ = 15.6 psf
h:	**0.5**	ft	*(Building mean roof height)*	F_h: $q_h(1.9)$ = 29.6 psf
z_g:	**80**	ft	*(Ground elevation)*	F_v: $q_h(1.5)$ = 23.4 psf
K_{zt}:	**1.00**		*(Topographic factor)*	

Maximum Anchor Forces (LRFD)

T_u:	55	lb	*(Seismic)*	T_u:	188	lb	*(Wind)*
V_u:	42	lb	*(Seismic)*	V_u:	84	lb	*(Wind)*
Ω_oT_u:	187	lb	*(Seismic)*				
Ω_oV_u:	84	lb	*(Seismic)*				



Maximum Anchor Forces (ASD)

T_a:	42	lb	*(Seismic)*	T_a:	106	lb	*(Wind)*
V_a:	29	lb	*(Seismic)*	V_a:	51	lb	*(Wind)*

Equations for Seismic Forces

$$T_{u1} = \left(F_pW_pC\Omega_o + \frac{F_{pv}W_pA}{2}\right)\frac{1}{2A} - \frac{0.9W_p}{4}$$

$$T_{u2} = \left(F_pW_pC\Omega_o + \frac{F_{pv}W_pB}{2}\right)\frac{1}{2B} - \frac{0.9W_p}{4}$$

$$T_u = max(T_{u1}, T_{u2})$$

$$V_u = \frac{\Omega_oF_pW_p}{4}$$

Equations for Wind Forces

$$T_{u1} = \left(DHF_hC + \frac{WDF_vA}{2}\right)\frac{1}{2A} - \frac{0.9W_p}{4}$$

$$T_{u2} = \left(WHF_hC + \frac{WDF_vB}{2}\right)\frac{1}{2B} - \frac{0.9W_p}{4}$$

$$T_u = max(T_{u1}, T_{u2})$$

$$V_u = \frac{\max(DHF_h, WHF_h)}{4}$$

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Equipment Anchorage Forces

- Determine maximum anchor forces for equipment due to wind and/or seismic forces.
- Seismic coefficients are per ASCE 7-16 CH 13.3
- Wind pressures are per ASCE 7-16 CH 29.4.1
- Assumes rectangular 4-anchor layout

Unit Information

Name: **(N) Ericsson B160 Cabinet**

W_p:	**1160** lb	*(Component operating weight)*				
W:	**26.0** in	*(Equipment width)*	A:	**20.0** in	*(Bolt spacing)*
D:	**26.0** in	*(Equipment depth)*	B:	**20.0** in	*(Bolt spacing)*
H:	**63.0** in	*(Equipment height)*	C:	**31.5** in	*(Height to center of gravity)*

Seismic Coefficients

S_{DS}:	**1.200** g	a_p:	**1.00**	F_p: $0.36W_p$ = 418 lb	*(Per Section 13.3.1)*
z/h:	**0.0** ft/ft	R_p:	**2.50**	F_{pv}: $0.24W_p$ = 278 lb	*(Per Section 13.3.2)*
I_p:	**1.00**	Ω_o:	**2.00**		

Wind Pressures

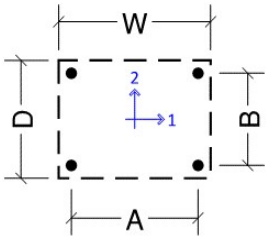
Unit is exposed to wind

Exposure:	**C**		q_h: $0.00256K_zK_{zt}K_dK_eV^2$
V:	**92** mph	*(Basic wind speed)*	q_h: $0.00256(0.85)(1.00)(0.85)(1.00)(92)^2$ = 15.6 psf
h:	**0.5** ft	*(Building mean roof height)*	F_h: $q_h(1.9)$ = 29.6 psf
z_g:	**80** ft	*(Ground elevation)*	F_v: $q_h(1.5)$ = 23.4 psf
K_{zt}:	**1.00**	*(Topographic factor)*	

Maximum Anchor Forces (LRFD)

T_u:	137 lb	*(Seismic)*	T_u:	32 lb	*(Wind)*
V_u:	104 lb	*(Seismic)*	V_u:	84 lb	*(Wind)*
Ω_oT_u:	466 lb	*(Seismic)*			
Ω_oV_u:	209 lb	*(Seismic)*			

Governing Anchor Forces



Maximum Anchor Forces (ASD)

T_a:	105 lb	*(Seismic)*	T_a:	2 lb	*(Wind)*
V_a:	73 lb	*(Seismic)*	V_a:	51 lb	*(Wind)*

Equations for Seismic Forces

$$T_{u1} = \left(F_pW_pC\Omega_o + \frac{F_{pv}W_pA}{2}\right)\frac{1}{2A} - \frac{0.9W_p}{4}$$

$$T_{u2} = \left(F_pW_pC\Omega_o + \frac{F_{pv}W_pB}{2}\right)\frac{1}{2B} - \frac{0.9W_p}{4}$$

$$T_u = max(T_{u1}, T_{u2})$$

$$V_u = \frac{\Omega_oF_pW_p}{4}$$

Equations for Wind Forces

$$T_{u1} = \left(DHF_hC + \frac{WDF_vA}{2}\right)\frac{1}{2A} - \frac{0.9W_p}{4}$$

$$T_{u2} = \left(WHF_hC + \frac{WDF_vB}{2}\right)\frac{1}{2B} - \frac{0.9W_p}{4}$$

$$T_u = max(T_{u1}, T_{u2})$$

$$V_u = \frac{\max(DHF_h, WHF_h)}{4}$$

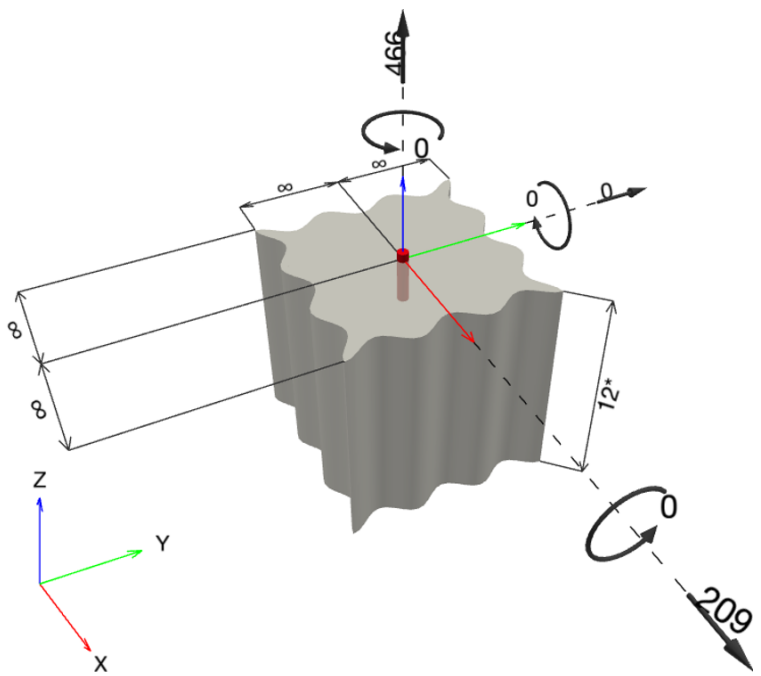
Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Dec 21, 2023	Date:	12/26/2023
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ2 - SS 316 1/2 (2) hnom1**
Item number:	2210264 KB-TZ2 1/2x3 3/4 SS316
Effective embedment depth:	$h_{ef,act}$ = 2.000 in., h_{nom} = 2.500 in.
Material:	AISI 316
Evaluation Service Report:	ESR-4266
Issued I Valid:	12/17/2021 | 12/1/2023
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 12.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: 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:	Concrete - Dec 21, 2023	Date:	12/26/2023
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 466; V_x = 209; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	37

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Dec 21, 2023	Date:	12/26/2023
Fastening point:			

2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Failure	466	1,284	37 / -	OK
Shear	Pryout Strength	209	1,844	- / 12	OK

Loading	**β_N**	**β_V**	**ζ**	**Utilization $\beta_{N,V}$ [%]**	**Status**
Combined tension and shear loads	0.363	0.113	5/3	22	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

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