PRCNC20231632

City of Puyallup
Building
ACCEPTED
JMontgomery
03/25/2024
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FULL SIZED LEDGIBLE COLOR REPORT IS REQUIRED TO BE PROVIDED BY THE PERMITTEE ON SITE FOR ALL INSPECTIONS

Project:	Tesla Charging Station		
Proj. No.:	N/A		
Designer:	CED	Date:	1/19/24
Sheet:		of	

Equipment Anchor & Foundation Calculations

for

TESLA CHARGING STATION
Puyallup, WA

Prepared by:

GPD GROUP
Professional Corporation

520 South Main Street; Suite 2531
Akron, OH 44311
(330) 572-2100

JOHN N. KABAK
STATE OF WASHINGTON
50892
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES 01/16/2025

01/19/2024

This analysis was analyzed following the 2021 Washington State Building Code. The scope of these calculations is limited to the design of the equipment anchors and equipment foundations. The structural capacity of the equipment itself is outside of the scope of this analysis.

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1. PROPOSED SITE PLAN

PRCNC20231632

SUPERCHARGER POST SCHEDULE

CABINET	POST	SIGN TYPE
1	1A	DEDICATED PARKING, VAN ACCESSIBLE
	1B	DEDICATED PARKING
	1C	DEDICATED PARKING
	1D	DEDICATED PARKING
2	2A	DEDICATED PARKING
	2B	DEDICATED PARKING
	2C	DEDICATED PARKING
	2D	DEDICATED PARKING
3	3A	DEDICATED PARKING
	3B	DEDICATED PARKING
	3C	DEDICATED PARKING
	3D	DEDICATED PARKING

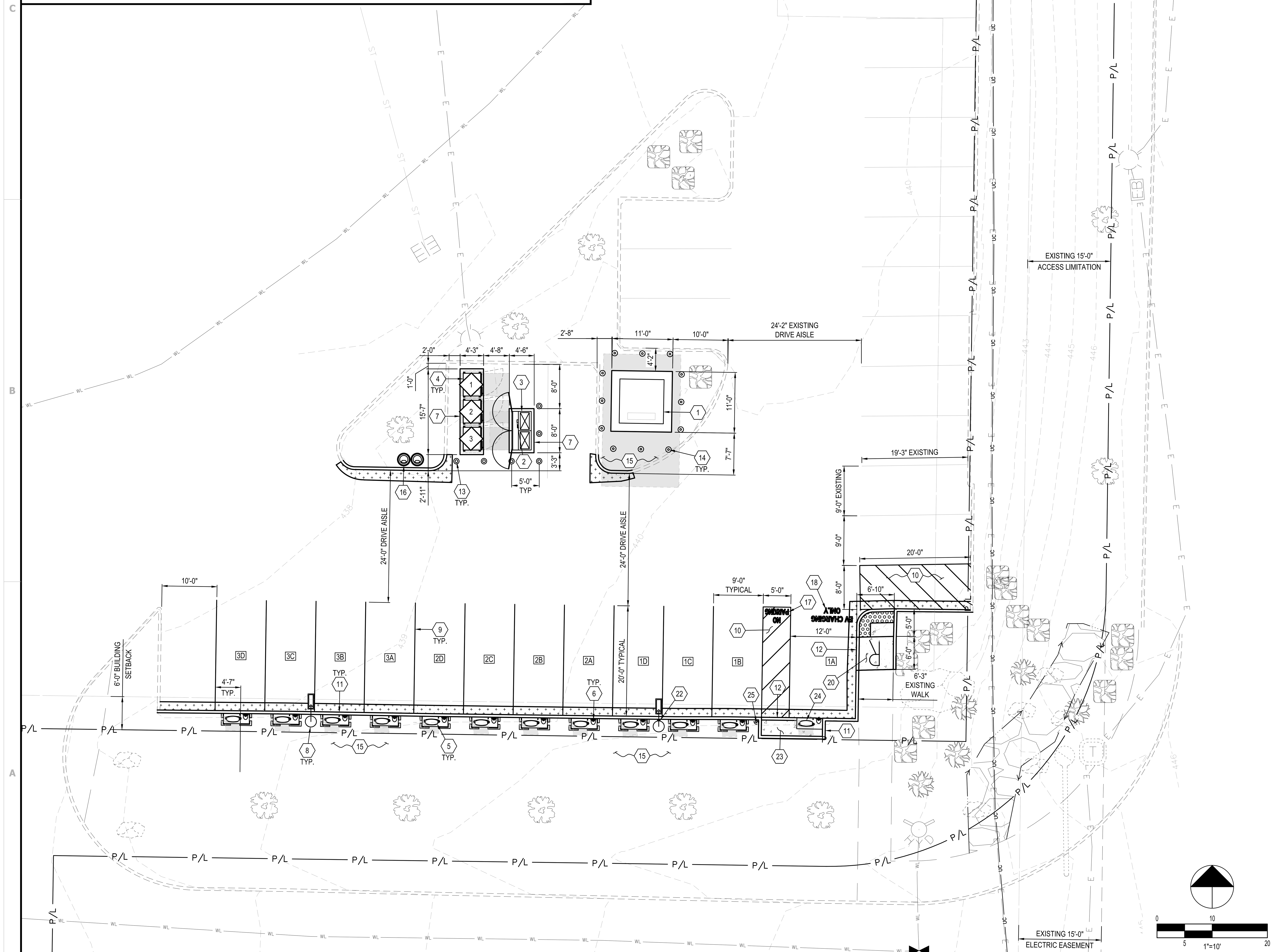
SIGNAGE

DEDICATED: TESLA VEHICLE CHARGING ONLY

VAN ACCESSIBLE: VAN ACCESSIBLE / DESIGNED FOR DISABLED ACCESS USE LAST

- WHITE SYMBOL
- WHITE TEXT
- SOLID FEDERAL BLUE #15090 IN FED STANDARD 595C BACKGROUND PAINT. SIGNS SHALL BE REFLECTORIZED.
- WHITE TEXT

PARKING STALL ANALYSIS	
EXISTING STALLS UTILIZED AS A RESULT OF THIS PROJECT	18
PROPOSED DCFC TESLA STALLS	12
PROPOSED NON-EV STALLS	3
NET STALL COUNT	-3



GENERAL SHEET NOTES

1. EXISTING PROPERTY LINES, RIGHT-OF-WAY BOUNDARIES, EASEMENT BOUNDARIES, SETBACKS, AND UTILITIES ARE SHOWN FOR REFERENCE ONLY.
2. CONTRACTOR SHALL REMOVE EXISTING PAVEMENT AND/OR CURB USING CLEAN SAWCUTS TO INSTALL PROPOSED UNDERGROUND CONDUITS AND REPLACE PAVEMENT AND/OR CURB AFTER CONDUITS HAVE BEEN INSTALLED. SEE ELECTRICAL SHEETS FOR CONDUIT ROUTING, APPROXIMATE CONDUIT RUN LENGTHS AND TRENCH DETAIL. CONTRACTOR SHALL MEET OR EXCEED EXISTING PAVEMENT SPECIFICATIONS. NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO PERFORMING WORK.
3. APPLY LIQUID ASPHALT AT ALL JOINTS BETWEEN CONCRETE AND ASPHALT AND WHERE PROPOSED ASPHALT MEETS EXISTING, INCLUDING SAW CUT JOINTS.
4. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING SLOPES AND GRADES PRIOR TO CONSTRUCTION. FINAL GRADES SHALL BE DETERMINED IN FIELD BY THE CONTRACTOR AND APPROVED BY THE CONSTRUCTION MANAGER.
5. THE CONTRACTOR SHALL ENSURE POSITIVE DRAINAGE TOWARDS THE NEAREST EXISTING DRAINAGE STRUCTURE AND ENSURE NO PONDING OCCURS ON SITE.
6. CONTRACTOR SHALL ENSURE SLOPES OF PARKING STALL 1A AND ADJACENT TRANSVERSE STRIPED AREA(S) ARE COMPLIANT WITH NATIONAL ADA STANDARDS. NO SLOPE SHALL EXCEED 2% IN ANY DIRECTION WITHIN PARKING STALL 1A AND ADJACENT TRANSVERSE STRIPED AREA(S). CONTRACTOR SHALL REMOVE AND REGRADE AREA(S) AS REQUIRED TO ACHIEVE NECESSARY SLOPES. CONTRACTOR SHALL INSTALL FINAL PAVEMENT MARKINGS IN ACCORDANCE WITH THE CURRENT AHJ'S REGULATIONS.

PLAN KEYNOTES

1. PROPOSED PAD MOUNTED ELECTRICAL UTILITY TRANSFORMER (BY UTILITY). CONTRACTOR SHALL PROVIDE CONCRETE PAD AND VAULT PER UTILITY SPECIFICATIONS. COORDINATE FINAL LOCATION WITH UTILITY. SEE ELECTRICAL PLANS FOR PROPOSED ROUTING.
2. PROPOSED UTILITY METER MOUNTED IN SWITCHGEAR PER ELECTRIC COMPANY SPECIFICATIONS AND DETAILS ON ELECTRICAL SHEETS.
3. PROPOSED SWITCHGEAR ASSEMBLY WITH INTEGRATED TESLA SITE CONTROLLER AND PRIMARY BROADCAST UNIT PER ELECTRICAL DRAWINGS. SEE CIVIL DETAILS FOR ANCHORAGE.
4. PROPOSED TESLA SUPERCHARGER CABINET (TYPICAL OF 3). SEE CIVIL DETAILS.
5. PROPOSED TESLA SUPERCHARGER POST WITH INDIVIDUAL PRECAST CONCRETE FOUNDATION AND ATTACHED DETERRENT BOLLARD (TYPICAL OF 11). SEE CIVIL DETAILS.
6. PROPOSED NON-ILLUMINATED PARKING SIGN (TYPICAL OF 12). SEE CIVIL DETAILS. SEE SUPERCHARGER POST SCHEDULE, THIS SHEET. MOUNT SIGN POST IN BOLLARD AS NOTED.
7. PROPOSED CONCRETE EQUIPMENT PAD. SEE CIVIL DETAILS.
8. PROPOSED LIGHT POLE (TOTAL OF 2), SEE CIVIL DETAILS. SEE ELECTRICAL DRAWINGS FOR POLE AND FIXTURE SPECIFICATIONS AND WIRING.
9. PROPOSED PAINTED 4" WIDE SOLID STRIPE TO MATCH EXISTING STRIPING IN COLOR. SEE PAVEMENT MARKING NOTES ON SHEET C-003.
10. PROPOSED PAINTED 4" WIDE TRANSVERSE STRIPING TO MATCH EXISTING STRIPING IN COLOR. STRIPING SHALL BE 3'-0" O.C. SEE PAVEMENT MARKING NOTES ON SHEET C-003 AND CIVIL DETAILS.
11. PROPOSED CONCRETE CURB TO MATCH EXISTING. SEE CIVIL DETAILS.
12. PROPOSED FLUSH CONCRETE CURB. SEE CIVIL DETAILS.
13. PROPOSED CRASHCORE DETERRENT BOLLARD (TYPICAL OF 6). SEE CIVIL DETAILS.
14. PROPOSED DETERRENT BOLLARD PER UTILITY SPECIFICATION (TYPICAL OF 12)
15. ALL DISTURBED AREAS NOT TO BE PAVED SHALL BE RETURNED TO MATCH EXISTING GROUND CONDITIONS UNLESS OTHERWISE NOTED. FINAL MATERIAL SHALL BE COORDINATED WITH TESLA.
16. PROPOSED TRASH CAN AND RECYCLING BIN (TYPICAL OF 1 EACH). SEE CIVIL DETAILS.
17. PROPOSED "NO PARKING" IN WHITE LETTERS, 12 INCHES. SEE PAVEMENT MARKING NOTES ON SHEET C-003.
18. PROPOSED "EV CHARGING ONLY" IN WHITE LETTERS, 12 INCHES. SEE PAVEMENT MARKING NOTES ON SHEET C-003.
19. PROPOSED UTILITY JUNCTION BOX PER UTILITY SPECIFICATION.
20. PROPOSED ACCESSIBLE CONCRETE RAMP. SEE CIVIL DETAILS.
21. PROPOSED CONCRETE CURB TAPER. SEE CIVIL DETAILS.
22. PROPOSED WIRELESS ACCESS POINT (TYPICAL OF 1). MOUNT PER MANUFACTURER'S SPECIFICATIONS AT MINIMUM 10'-0" ABOVE GRADE. WHERE APPLICABLE, CONTRACTOR SHALL MOUNT TO EXISTING LIGHT POLE.
23. PROPOSED CONCRETE ACCESSIBLE WALK. SEE CIVIL DETAILS.
24. PROPOSED TESLA SUPERCHARGER POST WITH INDIVIDUAL CAST-IN-PLACE CONCRETE FOUNDATION (TYPICAL OF 1). SEE CIVIL DETAILS.
25. PROPOSED NO PARKING SIGN ON POST. SEE CIVIL DETAILS.

LEGEND

(SEE SHEET C-003 FOR EXISTING LEGEND)

PROPOSED EQUIPMENT CLEAR SPACE

PROPOSED CONCRETE PAVEMENT TO MATCH EXISTING IN TYPE AND DEPTH. INCLUDE ENGINEERED COMPACTED BACKFILL BELOW PAVEMENT SECTION. TRENCHING NOT INCLUDED. CONTRACTOR SHALL REPLACE ANY FABRIC ENCOUNTERED DURING EXCAVATION INCLUDING BUT NOT LIMITED TO; GEOTEXTILE, WATER-PROOFING, PAVING FABRICS, ETC. THE REPLACEMENT MATERIAL(S) SHALL BE EQUAL TO OR BETTER THAN EXISTING AND SHALL BE CONFIRMED BY THE MANUFACTURER'S REPRESENTATIVE TO BE COMPATIBLE WITH THE EXISTING INSTALLATION.

PROPOSED ASPHALT PAVEMENT TO MATCH EXISTING IN TYPE AND DEPTH. INCLUDE ENGINEERED COMPACTED BACKFILL BELOW PAVEMENT SECTION. TRENCHING NOT INCLUDED. FOR FULL DEPTH REPLACEMENT, CONTRACTOR SHALL REPLACE ANY FABRIC ENCOUNTERED DURING EXCAVATION INCLUDING BUT NOT LIMITED TO; GEOTEXTILE, WATER-PROOFING, PAVING FABRICS, ETC. THE REPLACEMENT MATERIAL(S) SHALL BE EQUAL TO OR BETTER THAN EXISTING AND SHALL BE CONFIRMED BY THE MANUFACTURER'S REPRESENTATIVE TO BE COMPATIBLE WITH THE EXISTING INSTALLATION. IN LIEU OF FULL DEPTH REPLACEMENT, CONTRACTOR CAN MILL AND OVERLAY (1.5" MIN.) PROPOSED ASPHALT PROVIDED THAT THE FINAL ASPHALT SECTION IS EQUAL TO OR GREATER THAN THE EXISTING SECTION AND DRAINAGE AND ADA COMPLIANCE IS NOT NEGATIVELY AFFECTED.

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PALO ALTO, CA 94304
(650) 681-5000

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Professional Corporation
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Akron, OH 44311
330.572.2100 Fax 330.572.2101

REV.	DATE	DESCRIPTION
A	08/11/2023	ISSUED FOR 50% REVIEW
B	09/11/2023	ISSUED FOR 50% REVIEW
C	09/13/2023	ISSUED FOR 90% REVIEW
D	10/30/2023	ISSUED FOR SIGN & SEAL
E	01/19/2024	ISSUED FOR SIGN & SEAL - UTILITY UPDATES

TESLA SUPERCHARGER STATION
3310 S MERIDIAN ST. (TESLA SUPERCHARGER)
PUYALLUP, WA 98373

CIVIL SITE PLAN

PROJECT MANAGER	DESIGNER
IM	MAM

JOB NO.
2023241.47

C-111

Drawing Name: O:\2023\2023241\47 - TRT 27473 - South Hill Mall (Target) Puyallup, WA\dwg\2023241.47 - Puyallup, WA - CD100.dwg
January 19, 2024 1:42 PM - cdobay

2. SITE SPECIFIC WIND SEISMIC DESIGN MAP SUMMARY REPORT

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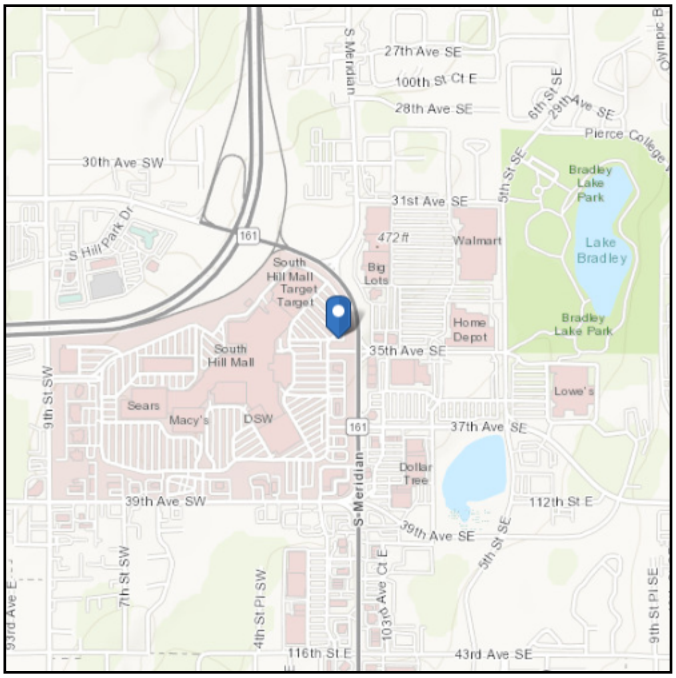
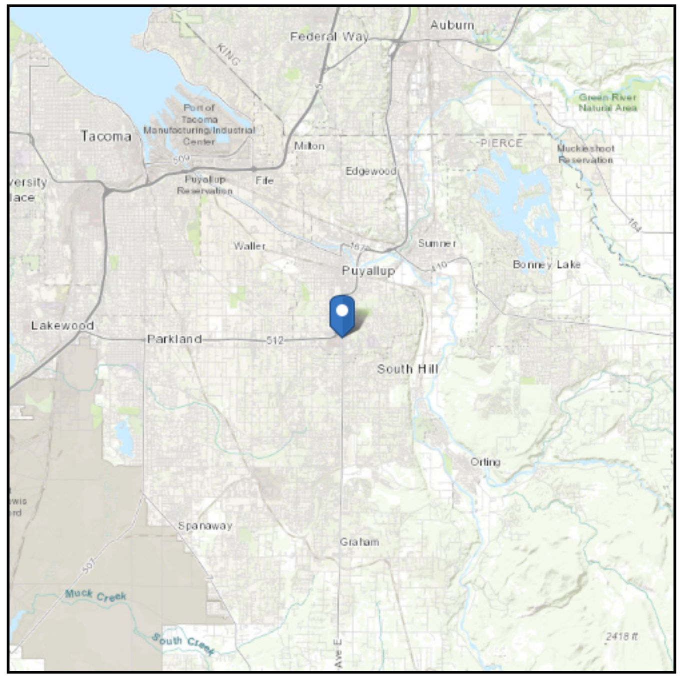
ASCE Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Latitude:**	47.15877
Risk Category:	II	**Longitude:**	-122.29369
Soil Class:	D - Default (see Section 11.4.3)	**Elevation:**	439.38375362064716 ft (NAVD 88)





Wind

Results:

Wind Speed	97 Vmph
10-year MRI	67 Vmph
25-year MRI	73 Vmph
50-year MRI	78 Vmph
100-year MRI	83 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:	Thu Jan 18 2024

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.

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ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

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

Results:

S_S :	1.263	S_{D1} :	N/A
S_1 :	0.436	T_L :	6
F_a :	1.2	PGA :	0.5
F_v :	N/A	PGA_M :	0.6
S_{MS} :	1.515	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.01	C_v :	1.353

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

Data Accessed: Thu Jan 18 2024

Date Source: USGS Seismic Design Maps

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3. V3 CHARGING CABINET ANCHOR CALCULATIONS

PRCNC20231632

ASCE 7-16 Wind Calculations
V3 Charging Cabinet Equipment Anchor Calculations

Wind Force Calculation		
Basic Wind Speed (Ultimate)	97	mph (Fig. 26.5-1B)
Risk Category	II	(Table 1.5-1)
Exposure Category	C	(Section 26.7)
Topographic Category	1	(Section 26.8 and Figure 26.8-1)
Z_g	900	(Table 26.11-1)
α	9.5	(Table 26.11-1)
K_d	0.85	(Section 26.6 and Table 26.6-1)
K_{zmin}	0.85	
K_{zt}	1.000	(Section 26.8.2)
K_e	1.000	(Section 26.9)
K_z	0.85	(Table 26.10-1) Max. of: ($K_z = 2.01 * (15 / Z_g)^{2/\alpha}$, or K_{zmin})
q_z	17.380	(Eq. 26.10-1 -- $qz = 0.00256 * K_z * K_{zt} * K_d * K_e * V^2$)
G	0.850	(Section 26.11)
C_f	1.314	(Fig. 29.4-1)
Wind Force on Equipment, F =	**593.4**	lbs (Eq. 29.4-1 -- $F = q_z * G * C_f * A_f$)
Overturning Moment, M =	**2213.0**	ft-lbs (M = F * d)
Equipment Properties		
Height (y) =	89.5	in
Width (x) =	37.8	in
Weight (w) =	2448	lbs
Length (b) =	49.2	in
Distance from Resultant Force (d) =	44.750	in (d = y / 2)**
Total Wind Area (A) =	30.58	ft^2
Equipment Anchorage Parameters		
Hilti Kwik Bolt TZ2 S.S. Anchor Dia. =	5/8	in
Anchor Embedment =	3.25	in
Concrete Strength =	2500	psi
Equipment Anchor in Tension (n_T) =	2	Anchors
Equipment Anchor in Shear (n_V) =	4	Anchors
Equipment Front Anchor Distance (x_{front}) =	0	in
Equipment Back Anchor Distance (x_{back}) =	33.86	in
Anchor ⊥ Edge Distance, (c1) =	8	in > c min (3.25 in)
Anchor ∥ Edge Distance, (c2) =	8	in > c min (3.25 in)
Equipment Anchor Spacing (s) =	6	in > s min (2.75 in)
Concrete Pad Thickness =	8	in > h min (5.5 in)
Equipment Reactions		
Max Tensile Reaction per Anchor (T) =	**-158.7**	lbs. ($T = (LF * F * d - 0.9 * w * s/2) / (s * n_T)$)
Max Shear Reaction per Anchor (V) =	**148.4**	lbs. ($V = LF * F / n_V$)
0.625" Dia. Hilti Kwik Anchor TZ2 S.S. Anchor (3.25" hef)		(ESR #:4266)
Anchor Tensile Strength (øNSA) =	**14125.0**	lbs. ($øN_{SA} = ø * A_{se,N} * f_{uta}$) ACI 318-14 Chapter 17
Anchor Shear Strength (øVSA) =	**8030.0**	lbs. determined by static shear tests with ϕVsa < ϕ 0.60 Ase,V futa as noted in ACI 318-14 Chapter 17.
Anchor Tension Pullout Capacity =	4000.0	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
Tension Spacing Factor, f_{AN} =	0.81	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Tension Edge Distance Factor, f_{RN} =	1	
Factored Anchor Tension Pullout Capacity =	**3240.0**	lbs. ($øNn * f_{AN} * f_{rn}$)
Anchor Shear Capacity =	8615.0	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
Shear Spacing Factor, f_{AV} =	0.6	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Shear ⊥ to Edge Factor, $f_{RV\perp}$ =	0.71	
Shear ∥ to Edge Factor, $f_{RV\parallel}$ =	1	
Shear Conc. Thickness Factor, f_{HV} =	0.73	
Factored Anchor Shear Capacity =	**2679.1**	lbs. ($øV_n * f_{AV} * f_{RV} * f_{HV}$)

Reduction factors based on Anchor spacing 6 in, an edge distance of 8 in, and a pad thickness of 8 in with 2500 psi concrete.

% Capacity Tension	**N/A**	**Acceptable - No Tension on Anchors**
% Capacity Shear	**5.5%**	**Acceptable**
% Shear & Tension Interaction	**5.5%**	**Acceptable**

*Assumed: (1) row of Anchors withstands tension created by overturning, while all Anchors share shear equally.

**Center of gravity is assumed to be at the middle of equipment.

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Seismic Demands on Nonbuilding Structure (ASCE 7-16)
V3 Charging Cabinet Equipment Anchor Calculations

Seismic Force Calculations (ASCE 7-16 Chapter 15)		
Component Weight, W =	2448	lbs.
S_{DS} =	1.011	
S_{D1} =	0.542	
S_1 =	0.436	
Seismic Design Category =	D	
Importance Factor, I_e =	1.0	Table 1.5-2
structure height, h_n =	7.458333333	ft
Nonbuilding Structure Type =	Mechanically anchored flat-bottom ground-supported tanks	
R=	3.00	Table 15.4-2
C_t =	0.02	Table 12.8-2
x =	0.75	Table 12.8-2
T_a =	0.090	$T_a = C_t * h_n^x$ -- Eq: 12.8-7
T_L =	6.000	
$C_{s\ max}$ =	2.00	when $T_a<T_L$, $C_s = S_{D1} / (T_a * R / I_e)$ -- ASCE 7-16 Eq: 12.8-3
$C_{s\ min1}$ =	0.044	C_s = max of: 0.044 * S_{DS} * I_e ; 0.03 -- ASCE 7-16 Eq: 15.4-1
$C_{s\ min2}$ =	N/A	$C_s = 0.8 * S_1 / (R / I_e)$ if S1 > 0.6g -- ASCE 7-16 Eq: 15.4-2
C_s =	0.34	$C_s = S_{DS} / (R / I_e)$ -- ASCE 7-16 Eq: 12.8-2 -- Controls
Seismic Force, F =	**825.0**	lbs. F = W * C_s -- Eq: 12.8-1
Overturning Seismic Moment, M =	**3076.5**	ft-lbs. (M = F * d)
Overstrength Factor, Ω =	2.0	Table 15.4-2
Factored Seismic Force, F' =	**1650.0**	lbs. (F' = F * Ω)
Factored Seismic Moment, M' =	**6152.9**	ft-lbs. (M' = M * Ω)
Equipment Properties		
Height (y) =	89.5	in
Width (x) =	37.8	in
Length (b) =	49.21	in
Weight (w) =	2448	lbs
Distance from Resultant Force (d) =	44.750	in (d = y / 2)**
Equipment Anchorage Parameters		
Hilti Kwik Bolt TZ2 S.S. Anchor Dia. =	5/8	in
Anchor Embedment =	3.25	in
Concrete Strength =	2500	psi
Equipment Anchor in Tension (n_T) =	2	Anchors
Equipment Anchor in Shear (n_V) =	4	Anchors
Equipment Front Anchor Distance (x_{front}) =	0	in
Equipment Back Anchor Distance (x_{back}) =	33.86	in
Anchor ⊥ Edge Distance, (c1) =	8	in > c min (3.25 in)
Anchor // Edge Distance, (c2) =	8	in > c min (3.25 in)
Equipment Anchor Spacing (s) =	6	in > s min (2.75 in)
Concrete Pad Thickness =	8	in > h min (5.5 in)
Equipment Anchor Reactions		
Max Tensile Reaction per Anchor (T) =	**663.2**	lbs. (T = (Ω * F * d - (0.9 - 0.2 * S_{DS}) * w * s/2) / (s * n_T)
Max Shear Reaction per Anchor (V) =	**412.5**	lbs. (V = Ω * F / n_V)
0.625" Dia. HILTI KB-TZ2 S.S. Anchor (3.25" hef)		(ESR #:4266)
Anchor Tensile Strength (øNSA) =	**14125**	lbs. ($øN_{SA} = ø * A_{se,N} * f_{uta}$) ACI 318-19 Chapter 17
Anchor Shear Strength (øVSA) =	**8030**	lbs. determined by static shear tests with ϕVsa < ϕ 0.60 Ase,V futa as noted in ACI 318-19 Chapter 17.
Anchor Seismic Shear Strength (ØVsa,eq)=	**8030**	lbs. determined by seismic shear tests with ϕVsa,eq < ϕ 0.60 Ase,V futa as noted in ACI 318-19 Chapter 17.
Anchor Tension Pullout Capacity, $øN_n$ =	4000	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
αN,seis =	0.75	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Tension Spacing Factor, f_{AN} =	0.81	
Tension Edge Distance Factor, f_{RN} =	1	
Anchor Tension Pullout Capacity =	**2430.0**	lbs. ($øNn * α_{N,seis} * f_{AN} * f_{rn}$)
Anchor Shear Capacity, øVn =	8615	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
Shear Spacing Factor, f_{AV} =	0.6	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Shear ⊥ to Edge Factor, $f_{RV⊥}$ =	0.71	
Shear // to Edge Factor, $f_{RV//}$ =	1	
Shear Conc. Thickness Factor, f_{HV} =	0.73	
Anchor Shear Capacity (Cr. Conc.) =	**2679.1**	lbs. ($øV_n * f_{AV} * f_{RV⊥} * f_{RV//} * f_{HV}$)

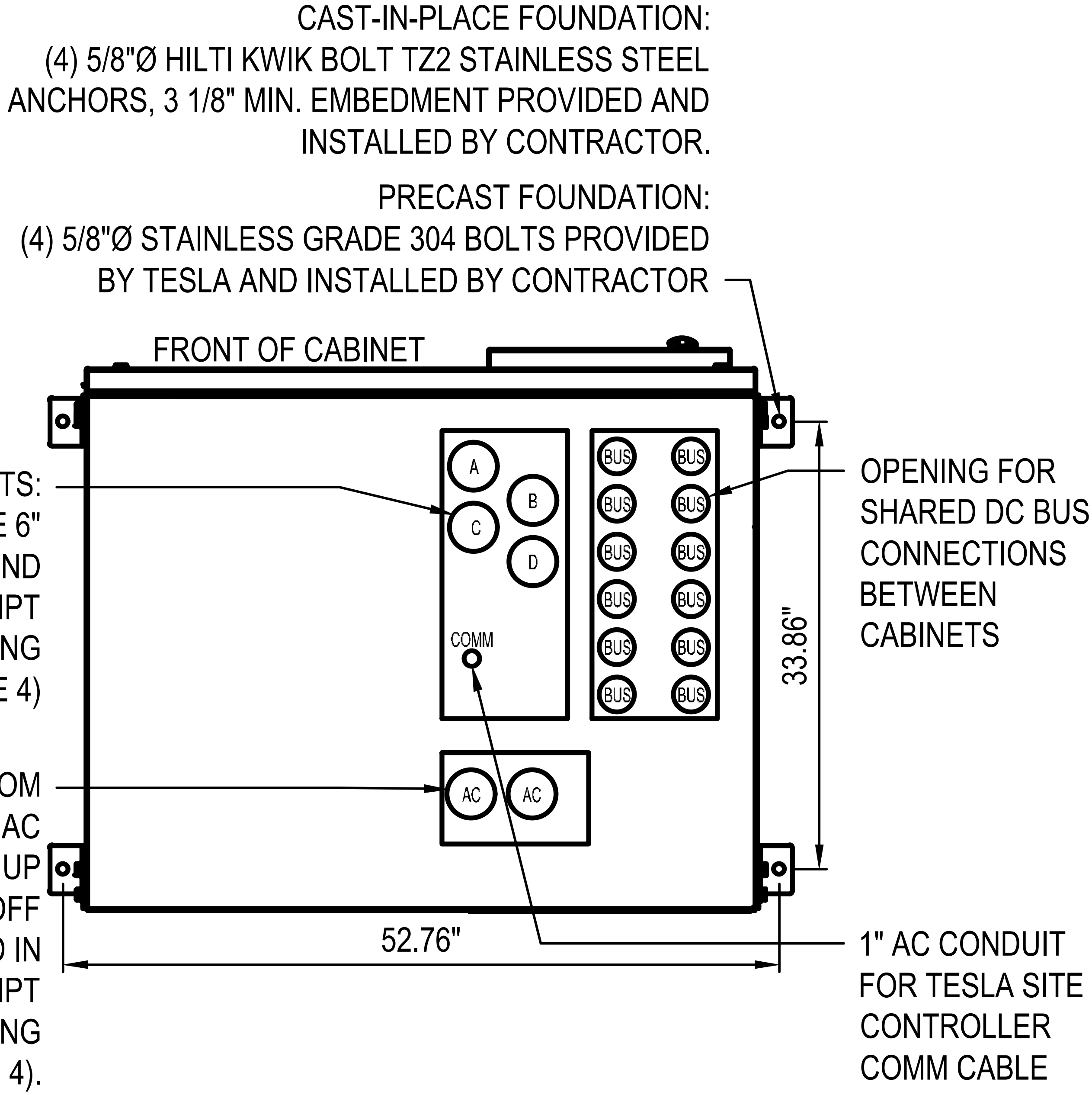
Reduction factors based on Anchor spacing 6 in, an edge distance of 8 in, and a pad thickness of 8 in with 2500 psi concrete.

% Capacity Tension	**27.3%**	**Acceptable**
% Capacity Shear	**15.4%**	**Acceptable**
% Shear & Tension Interaction	**42.7%**	**Acceptable**

*Assumed: (1) row of Anchors withstands tension created by overturning, while all Anchors share shear equally.

**Center of gravity is assumed to be at the middle of equipment.

PRCNC20231632



NOTE:

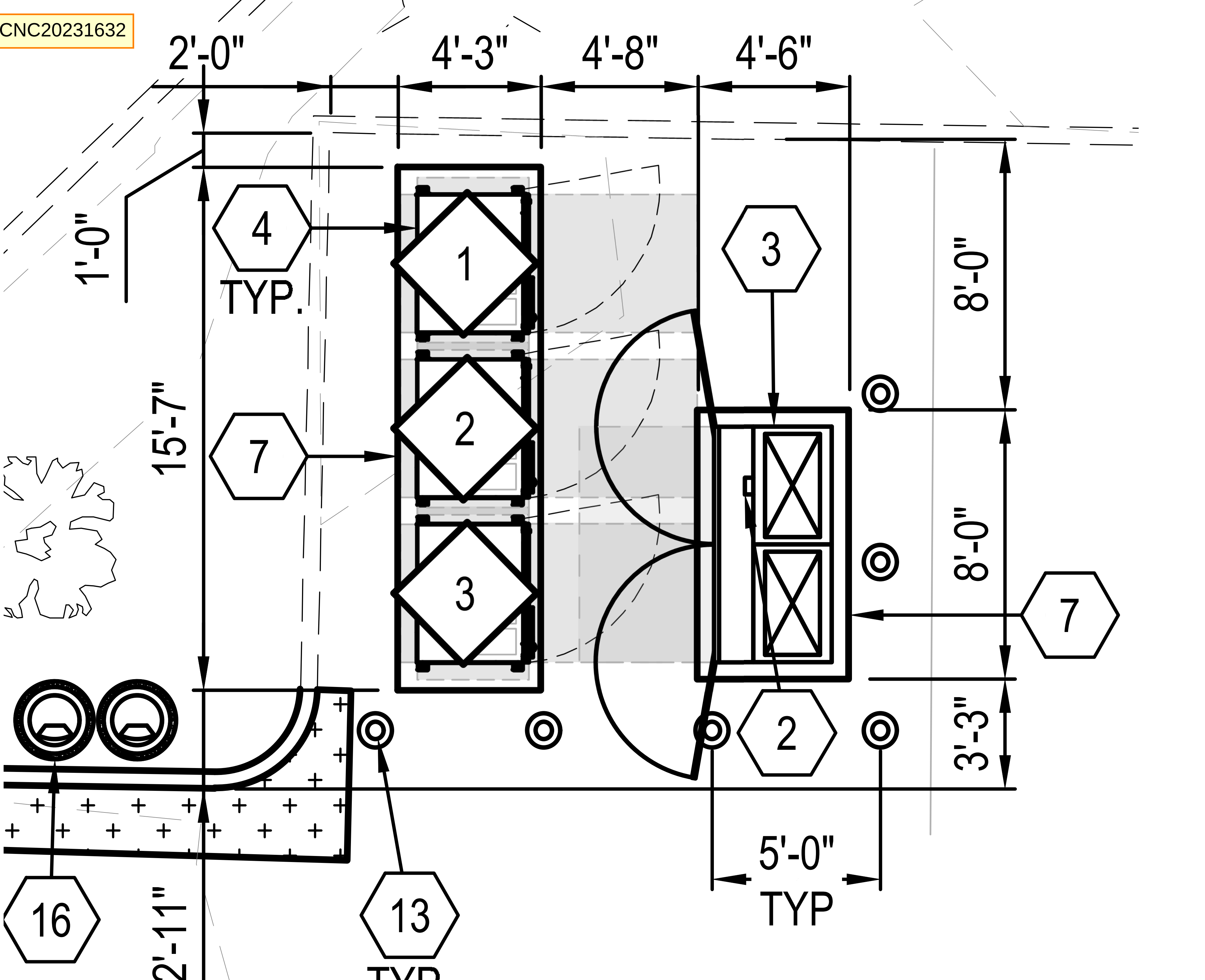
1. TESLA PROVIDED TEMPLATE PLATE TO BE USED TO LAYOUT CHARGING CABINET ANCHORING BOLT LOCATIONS AND CONDUIT STUB UP LOCATIONS.
2. BOLT HOLES FOR REFERENCE ONLY.
3. USE DOTTIE DUCT SEAL COMPOUND PC 6130 (CAT NO LHD1) TO SEAL ENDS OF CONDUIT (TYP. ALL CONDUITS FOR CHARGING CABINETS AND CHARGE POSTS)
4. USE BELL FITTINGS ON ALL AC AND DC CONDUIT STUBS
5. SEE DETAIL THIS SHEET FOR FOUNDATION DETAIL IF APPLICABLE

C-5

TESLA SUPERCHARGER CABINET ANCHOR BOLT PLAN

NTS

PRCNC20231632



4. V4 CHARGING POST ANCHOR CALCULATIONS

PRCNC20231632

ASCE 7-16 Wind Calculations - Charging Post Anchor Calcuations
Tesla Supercharging Station
(values used for calculations are assumed worst case values)

Wind Force Calculation on Charging Post		
Basic Wind Speed (Ultimate)	97	mph (Fig. 26.5-1B)
Risk Category	II	(Table 1.5-1)
Exposure Category	c	(Section 26.7)
Topographic Category	1	(Section 26.8 and Figure 26.8-1)
Z_g	900	(Table 26.11-1)
α	9.5	(Table 26.11-1)
K_d	0.85	(Section 26.6 and Table 26.6-1)
K_{zmin}	0.85	
K_{zt}	1.00	(Section 26.8.2)
K_e	1.000	(Section 26.9)
K_z	0.85	(Table 26.10-1) Max. of: ($K_z = 2.01 * (15 / Z_g)^{2/\alpha}$, or K_{zmin})
q_z	16.67	(Eq. 26.10-1 -- $qz = 0.00256 * K_z * K_{zt} * K_d * K_e * V^2$)
G	0.85	(Section 26.11)
C_f	1.33	(Fig. 29.4-1)
Wind Force on Charge Post (F_{post})	**269.7**	lbs (Eq. 29.4-1 -- $F = q_z * G * C_f * A_f$)
Load Factor (LF)	**1.0**	

Charging Post Properties		
Height (y) =	76.6	in (provided in Supercharger Datasheet)
Weight (Wp) =	200	lbs (provided in Supercharger Datasheet)
Width (b) =	26.77	in (provided in Supercharger Datasheet)
z =	3.19	ft
Area (A_f) =	14.30	ft^2 (Area determined by CAD file provided by Tesla)

Max. Resultant Wind Forces on Bolts		
Distance from Resultant Force (d) =	38.3	in (d = y / 2)**
Anchor Bolt Quantity (n) =	4	bolts
Anchor Bolt Spacing (s) =	4.72	in (provided in Supercharger Datasheet)
Max Bolt Tension (T_{post})* =	**1139.26**	lbs. $T_{post} = (LF * F_{post} * d + 0.9 * Wp * s/2) / (s * n/2)$
Max Bolt Shear (V_{post})* =	**67.4**	lbs. ($V_{post} = LF * F_{post} / n$)

1/2" ø HAS-R Threaded Rod (6" embed)		(Epoxy strength based on Hilti HIT-HY 200 V3 epoxy - ESR-4868)
Bolt Tensile Strength ($øN_t$) =	10,650	lbs. ($øN_t = ø * A_{net} * f_{ut}$) = ($0.75 * 0.142in^2 * 100,000psi$)
Bolt Shear Strength ($øN_v$) =	7,644	lbs. ($øN_v = ø * 0.6 * A_g * f_y$) = ($1.0 * 0.60 * 0.196in^2 * 65,000psi$)
Bolt Tension Pullout Capacity (Cr. Conc.) =	4,267	lbs. ($øNn * f_{AN} * f_{RN}$) = (6,995lbs * 0.61 *1.0)
Bolt Shear Pullout Capacity (Cr. Conc.) =	3,756	lbs. ($øV_n * f_{AV} * f_{RV} * f_{HV}$) = (14,975lbs * 0.55 * 0.48 * 0.95)

--Reduction factors based on bolt spacing 4-23/32", an edge distance of 9", and a concrete pad thickness of 1'-9" with 2500psi concrete.--

% Capacity Tension	**26.7%**	**Acceptable**
% Capacity Shear	**1.8%**	**Acceptable**
% Combined Shear & Tension	**26.7%**	**Acceptable**

*Assumed: (1) row of bolts withstands tension created by overturning, while all bolts share shear equally.

**Center of gravity is assumed to be at the geometric center of charging post

PRCNC20231632

Seismic Demands on Nonstructural Components (ASCE 7-16)
Charging Post Anchor Calcuations
(values used for calculations are assumed worst case values)

Seismic Force Calculations (ASCE 7-16 Chapter 15)		
Component Weight, W_{post} =	200	lbs.
S_{DS} =	1.010	
Importance Factor, I_e =	1.0	Table 1.5-2
structure height, h_n =	6.383333333	ft
Nonbuilding Structure Type =	Mechanically anchored flat-bottom ground-supported tanks	
R=	3.00	Table 15.4-2
C_t =	0.02	Table 12.8-2
x =	0.75	Table 12.8-2
T_a =	0.080	$T_a = C_t * h_n^x$ -- Eq: 12.8-7
T_L =	6.000	
$C_{s\ max}$ =	4.15	when T_a<T_L, $C_s = S_{D1} / (T_a * R / I_e)$ -- ASCE 7-10 Eq: 12.8-3
$C_{s\ min1}$ =	0.044	C_s = max of: 0.044 * S_{DS} * I_e ; 0.03 -- ASCE 7-10 Eq: 15.4-1
$C_{s\ min2}$ =	0.27	$C_s = 0.8 * S_1 / (R / I_e)$ if S1 > 0.6g -- ASCE 7-10 Eq: 15.4-2
C_s =	0.34	$C_s = S_{DS} / (R / I_e)$ -- ASCE 7-10 Eq: 12.8-2 -- Controls
Seismic Force, F_{post} =	**67.33**	lbs. F = W * C_s -- Eq: 12.8-1
Overstrength Factor (Ω)	2.0	Table 15.4-2

Required Anchor Bolt Strength		
Center of Gravity Elevation (d) =	38.3	in (d = y / 2)**
Anchor Bolt Quantity (n) =	4	bolts
Anchor Bolt Spacing (s) =	4.72	in (provided in Supercharger Datasheet)
Max Bolt Tension (T_{post})* =	**581.27**	lbs. $T_{post} = (Ω * F_{post} * d + (0.9 - 0.2 * S_{DS}) * W_{post} * s/2) / (s * n/2)$
Max Bolt Shear (V_{post})* =	**33.67**	lbs. ($V_{post} = Ω * F_{post} / n$)

1/2" ø HAS-R Threaded Rod (6" embed)		(Epoxy strength based on Hilti HIT-HY 200 V3 epoxy - ESR-4868)
Bolt Tensile Strength ($øN_t$) =	10,650	lbs. ($øN_t = ø * A_{net} * f_{ut}$) = (0.75 * 0.142$in^2$ * 100,000psi)
Bolt Shear Strength ($øN_v$) =	7,644	lbs. ($øN_v = ø * 0.6 * A_g * f_v$) = (1.0 * 0.60 * 0.196$in^2$ * 65,000psi)
Bolt Tension Pullout Capacity (Cr. Conc.) =	3,158	lbs. ($øNn * α_{seis} * f_{AN} * f_{RN}$) = (6,995lbs * 0.61 * 1.0 * 0.74)
Bolt Shear Pullout Capacity (Cr. Conc.) =	2,779	lbs. ($øV_n * f_{AV} * f_{RV} * f_{HV} * α_{seis}$) = (14,975lbs * 0.55 * 0.48 * 0.95 * 0.74)

--Reduction factors based on bolt spacing 4-23/32", an edge distance of 9", and a concrete pad thickness of 1'-9" with 2500psi concrete.--

% Capacity Tension	**18.4%**	**Acceptable**
% Capacity Shear	**1.2%**	**Acceptable**
% Combined Shear & Tension	**19.6%**	**Acceptable**

*Assumed: (1) row of bolts withstands tension created by overturning, while all bolts share shear equally.

**Center of gravity is assumed to be at the geometric center of charging post

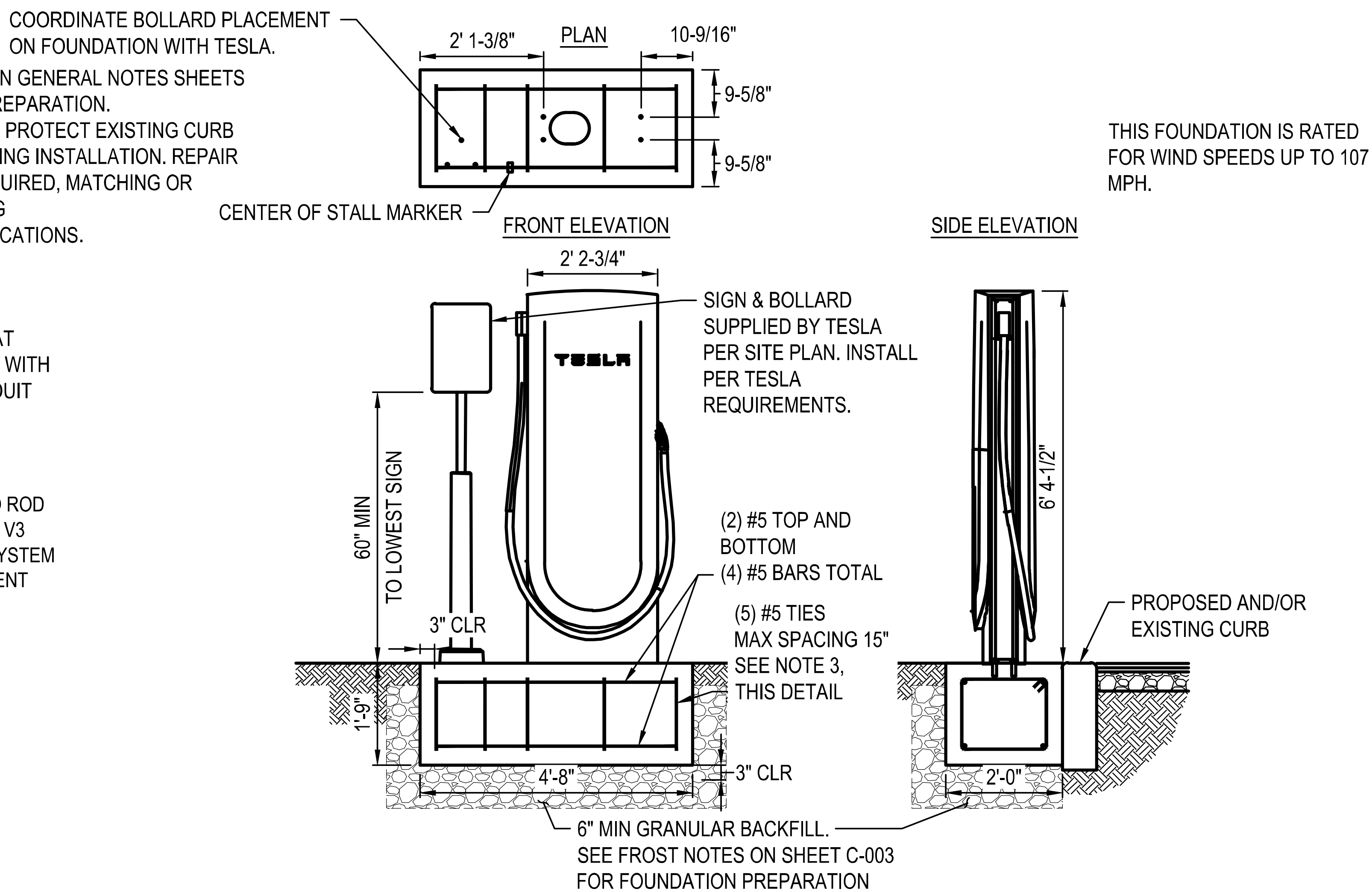
PRCNC20231632

NOTES

1. SEE FROST NOTES ON GENERAL NOTES SHEETS FOR FOUNDATION PREPARATION.
2. CONTRACTOR SHALL PROTECT EXISTING CURB AND PAVEMENT DURING INSTALLATION. REPAIR OR REPLACE AS REQUIRED, MATCHING OR EXCEEDING EXISTING CONDITIONS/SPECIFICATIONS.
3. CONTRACTOR SHALL PLACE REBAR IN A CONFIGURATION THAT DOES NOT CONFLICT WITH ANCHORS AND CONDUIT WINDOW

ANCHORAGE NOTES

1. 1/2" DIA SS THREADED ROD WITH HILTI HIT-HY 200 V3 ADHESIVE ANCHOR SYSTEM WITH 6" MIN EMBEDMENT PER ESR-4868, OR APPROVED EQUAL.



C-2

TESLA SUPERCHARGER CAST-IN-PLACE FOUNDATION

N.T.S

5. SWITCHGEAR ANCHOR CALCULATIONS

PRCNC20231632

ASCE 7-16 Wind Calculations
Switchgear Equipment Anchor Calculations

Wind Force Calculation		
Basic Wind Speed (Ultimate)	97	mph (Fig. 26.5-1B)
Risk Category	II	(Table 1.5-1)
Exposure Category	C	(Section 26.7)
Topographic Category	1	(Section 26.8 and Figure 26.8-1)
Z_g	900	(Table 26.11-1)
α	9.5	(Table 26.11-1)
K_d	0.85	(Section 26.6 and Table 26.6-1)
K_{zmin}	0.85	
K_{zt}	1.000	(Section 26.8.2)
K_e	1.000	(Section 26.9)
K_z	0.85	(Table 26.10-1) Max. of: ($K_z = 2.01 * (15 / Z_g)^{2/α}$, or K_{zmin})
q_z	17.380	(Eq. 26.10-1 -- $qz = 0.00256 * K_z * K_{zt} * K_d * K_e * V^2$)
G	0.850	(Section 26.11)
C_f	1.301	(Fig. 29.4-1)
Wind Force on Equipment, F =	**1009.2**	lbs (Eq. 29.4-1 -- $F = q_z * G * C_f * A_f$)
Overturning Moment, M =	**3784.4**	ft-lbs (M = F * d)
Equipment Properties		
Height (y) =	90	in
Width (x) =	42	in
Weight (w) =	2600	lbs
Length (b) =	84	in
Distance from Resultant Force (d) =	45.000	in (d = y / 2)**
Total Wind Area (A) =	52.50	ft^2
Equipment Anchorage Parameters		
Hilti Kwik Bolt TZ2 S.S. Anchor Dia. =	1/2	in
Anchor Embedment =	3.25	in
Concrete Strength =	2500	psi
Equipment Anchor in Tension (n_T) =	6	Anchors
Equipment Anchor in Shear (n_V) =	12	Anchors
Equipment Front Anchor Distance (x_{front}) =	17.25	in
Equipment Back Anchor Distance (x_{back}) =	38.75	in
Anchor ⊥ Edge Distance, (c1) =	8	in > c min (2.25 in)
Anchor ∥ Edge Distance, (c2) =	8	in > c min (2.25 in)
Equipment Anchor Spacing (s) =	12	in > s min (2 in)
Concrete Pad Thickness =	8	in > h min (5.5 in)
Equipment Reactions		
Max Tensile Reaction per Anchor (T) =	**157.0**	lbs. ($T = (LF * F * d - 0.9 * w * s/2) / (s * n_T)$)
Max Shear Reaction per Anchor (V) =	**84.1**	lbs. ($V = LF * F / n_V$)
0.5" Dia. Hilti Kwik Anchor TZ2 S.S. Anchor (3.25" hef)		(ESR #:4266)
Anchor Tensile Strength (øNSA) =	**8905.0**	lbs. ($øN_{SA} = ø * A_{se,N} * f_{uta}$) ACI 318-14 Chapter 17
Anchor Shear Strength (øVSA) =	**5425.0**	lbs. determined by static shear tests with ϕVsa < ϕ 0.60 Ase,V futa as noted in ACI 318-14 Chapter 17.
Anchor Tension Pullout Capacity =	3235.0	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
Tension Spacing Factor, f_{AN} =	1	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Tension Edge Distance Factor, f_{RN} =	1	
Factored Anchor Tension Pullout Capacity =	**3235.0**	lbs. ($øNn * f_{AN} * f_{rn}$)
Anchor Shear Capacity =	6970.0	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
Shear Spacing Factor, f_{AV} =	0.72	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Shear ⊥ to Edge Factor, $f_{RV⊥}$ =	0.82	
Shear ∥ to Edge Factor, $f_{RV∥}$ =	1	
Shear Conc. Thickness Factor, f_{HV} =	0.76	
Factored Anchor Shear Capacity =	**3127.5**	lbs. ($øV_n * f_{AV} * f_{RV} * f_{HV}$)

Reduction factors based on Anchor spacing 12 in, an edge distance of 8 in, and a pad thickness of 8 in with 2500 psi concrete.

% Capacity Tension	**4.9%**	**Acceptable**
% Capacity Shear	**2.7%**	**Acceptable**
% Shear & Tension Interaction	**7.5%**	**Acceptable**

*Assumed: (1) row of Anchors withstands tension created by overturning, while all Anchors share shear equally.

**Center of gravity is assumed to be at the middle of equipment.

PRCNC20231632

Seismic Demands on Nonbuilding Structure (ASCE 7-16)
Switchgear Equipment Anchor Calculations

Seismic Force Calculations (ASCE 7-16 Chapter 15)		
Component Weight, W =	2600	lbs.
S_{DS} =	1.011	
S_{D1} =	0.542	
S_1 =	0.436	
Seismic Design Category =	D	
Importance Factor, I_e =	1.0	Table 1.5-2
structure height, h_n =	7.5	ft
Nonbuilding Structure Type =	Mechanically anchored flat-bottom ground-supported tanks	
R=	3.00	Table 15.4-2
C_t =	0.02	Table 12.8-2
x =	0.75	Table 12.8-2
T_a =	0.091	$T_a = C_t * h_n^x$ -- Eq: 12.8-7
T_L =	6.000	
$C_{s\ max}$ =	1.99	when $T_a<T_L$, $C_s = S_{D1} / (T_a * R / I_e)$ -- ASCE 7-16 Eq: 12.8-3
$C_{s\ min1}$ =	0.044	C_s = max of: $0.044 * S_{DS} * I_e$; 0.03 -- ASCE 7-16 Eq: 15.4-1
$C_{s\ min2}$ =	N/A	$C_s = 0.8 * S_1 / (R / I_e)$ if S1 > 0.6g -- ASCE 7-16 Eq: 15.4-2
C_s =	0.34	$C_s = S_{DS} / (R / I_e)$ -- ASCE 7-16 Eq: 12.8-2 -- <u>Controls</u>
Seismic Force, F =	**876.2**	lbs. F = W * C_s -- Eq: 12.8-1
Overturning Seismic Moment, M =	**3285.8**	ft-lbs. (M = F * d)
Overstrength Factor, Ω =	2.0	Table 15.4-2
Factored Seismic Force, F' =	**1752.4**	lbs. (F' = F * Ω)
Factored Seismic Moment, M' =	**6571.5**	ft-lbs. (M' = M * Ω)
Equipment Properties		
Height (y) =	90	in
Width (x) =	42	in
Length (b) =	84	in
Weight (w) =	2600	lbs
Distance from Resultant Force (d) =	45.000	in (d = y / 2)**
Equipment Anchorage Parameters		
Hilti Kwik Bolt TZ2 S.S. Anchor Dia. =	1/2	in
Anchor Embedment =	3.25	in
Concrete Strength =	2500	psi
Equipment Anchor in Tension (n_T) =	6	Anchors
Equipment Anchor in Shear (n_V) =	12	Anchors
Equipment Front Anchor Distance (x_{front}) =	17.25	in
Equipment Back Anchor Distance (x_{back}) =	38.75	in
Anchor ⊥ Edge Distance, (c1) =	8	in > c min (2.25 in)
Anchor // Edge Distance, (c2) =	8	in > c min (2.25 in)
Equipment Anchor Spacing (s) =	12	in > s min (2 in)
Concrete Pad Thickness =	8	in > h min (5.5 in)
Equipment Anchor Reactions		
Max Tensile Reaction per Anchor (T) =	**460.1**	lbs. $(T = (\Omega * F * d - (0.9 - 0.2 * S_{DS}) * w * s/2) / (s * n_T)$
Max Shear Reaction per Anchor (V) =	**146.0**	lbs. $(V = \Omega * F / n_V)$
0.5" Dia. HILTI KB-TZ2 S.S. Anchor (3.25" hef)		(ESR #:4266)
Anchor Tensile Strength (øNSA) =	**8905**	lbs. $(øN_{SA} = ø * A_{se,N} * f_{uta})$ ACI 318-19 Chapter 17
Anchor Shear Strength (øVSA) =	**5425**	lbs. determined by static shear tests with $\phi V_{sa} < \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318-19 Chapter 17.
Anchor Seismic Shear Strength (ØVsa,eq)=	**5425**	lbs. determined by seismic shear tests with $\phi V_{sa,eq} < \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318-19 Chapter 17.
Anchor Tension Pullout Capacity, $øN_n$ =	3235	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
αN,seis =	0.75	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Tension Spacing Factor, f_{AN} =	1	
Tension Edge Distance Factor, f_{RN} =	1	
Anchor Tension Pullout Capacity =	**2426.3**	lbs. $(øNn * \alpha_{N.seis} * f_{AN} * f_{rn})$
Anchor Shear Capacity, øVn =	6970	lbs. *Design Strength from HILTI Simplified Design Tables (Cracked Concrete)*
Shear Spacing Factor, f_{AV} =	0.72	
Shear ⊥ to Edge Factor, $f_{RV\perp}$ =	0.82	} *Adjustment Factors from HILTI Simplified Design Tables for stainless steel anchor in cracked concrete*
Shear // to Edge Factor, $f_{RV\ //}$ =	1	
Shear Conc. Thickness Factor, f_{HV} =	0.76	
Anchor Shear Capacity (Cr. Conc.) =	**3127.5**	lbs. $(øV_n * f_{AV} * f_{RV\perp} * f_{RV\ //} * f_{HV})$

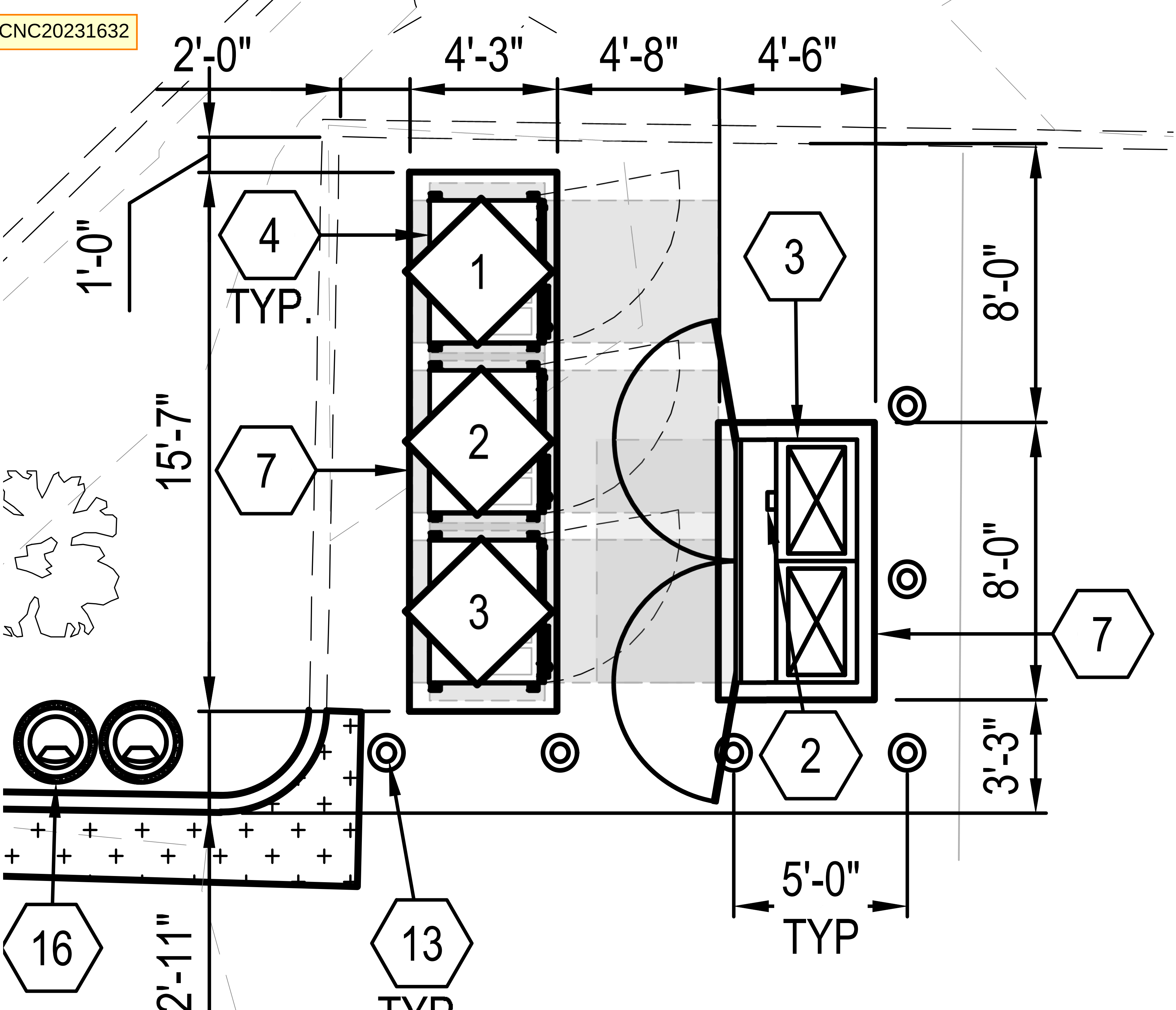
Reduction factors based on Anchor spacing 12 in, an edge distance of 8 in, and a pad thickness of 8 in with 2500 psi concrete.

% Capacity Tension	**19.0%**	**Acceptable**
% Capacity Shear	**4.7%**	**Acceptable**
% Shear & Tension Interaction	**23.6%**	**Acceptable**

*Assumed: (1) row of Anchors withstands tension created by overturning, while all Anchors share shear equally.

**Center of gravity is assumed to be at the middle of equipment.

PRCNC20231632



PRCNC20231632

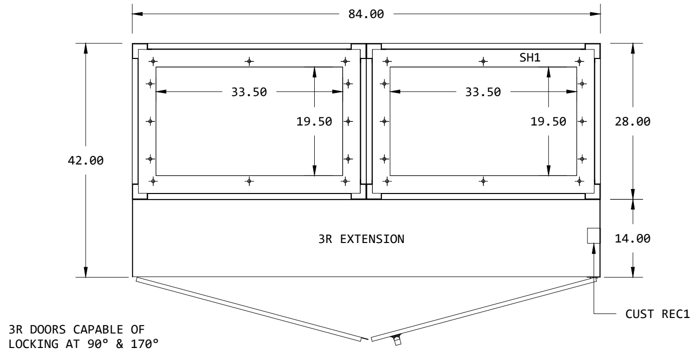
SPECIFICATIONS

1. CONSTRUCTION
UL TYPE 3R, GA. STEEL, OSHPD OSP-0308-10, UL 891 FILE E337533 c UL US LISTED

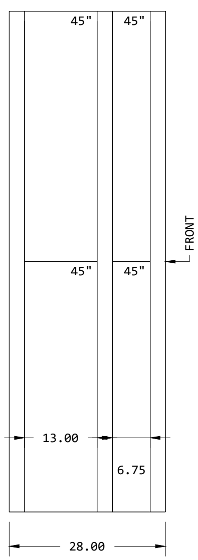
2. FINISH
CARDINAL T007-WH121 POWDER COAT, WHITE, 70% GLOSS

3. SERVICE
PUGET SOUND ENERGY, 1600A BUS, 480Y/277VAC, 3ϕ 4W, 65KAIC

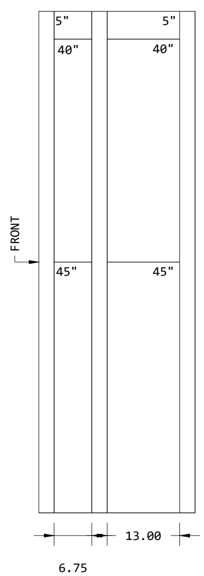
4. BUS
PLATED COPPER



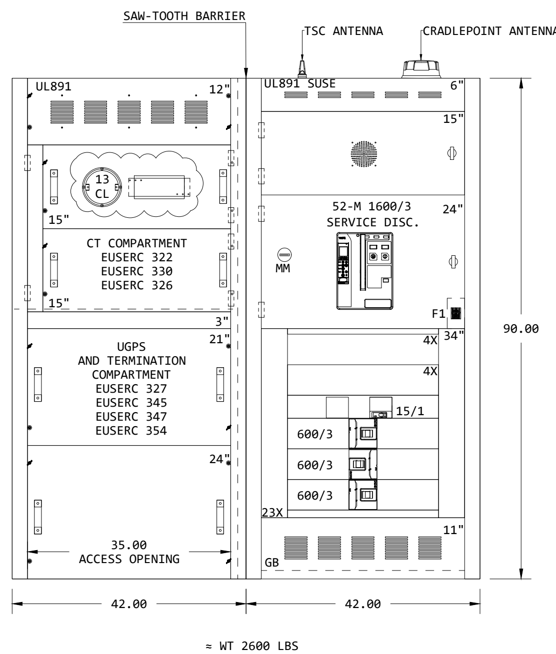
BASE LAYOUT/CONDUIT PLAN



LEFT ELEVATION
SHOWN WITH 3R COMPONENTS
REMOVED FOR CLARITY



RIGHT ELEVATION
SHOWN WITH 3R COMPONENTS
REMOVED FOR CLARITY



FRONT ELEVATION
SHOWN WITH 3R COMPONENTS
REMOVED FOR CLARITY

POWER & DISTRIBUTION
16450 PHOEBE AVENUE
LA MIRADA, CA 90638
PHONE: (714)-307-9198

CUSTOMER APPROVAL:

SITE NAME/LOCATION:
TESLA SUPERCHARGER
SERVICE SWBD "MDP-1"
3310 S MERIDIANT ST.
PUYALLUP, WA 98373

#	REVISION	DATE
0	ISSUED FOR APPROVAL	11/24/23
1	INTERNAL METER	11/24/23

DRAWING: 2310-3-16478

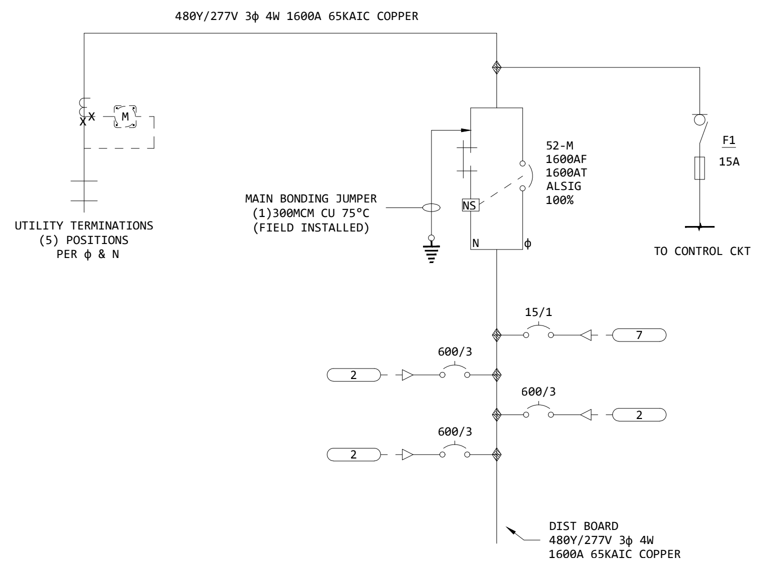
SHEET DESCRIPTION: ELEVATIONS/SPECS.

DRAWN BY:	SHEET:
AB	1
REV:	PAPER:
1	8.5"X 11"

Y:\T\~Tesla-ALL\TESLA_Superchargers\1_Washington_\3310 S Meridian St Puyallup, WA _1600A_16478

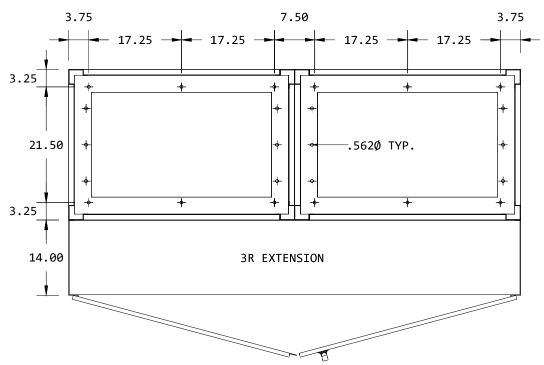
PLOT DATE: 11/24/2023 11:51 AMBY: ANHBUI

PRCNC20231632

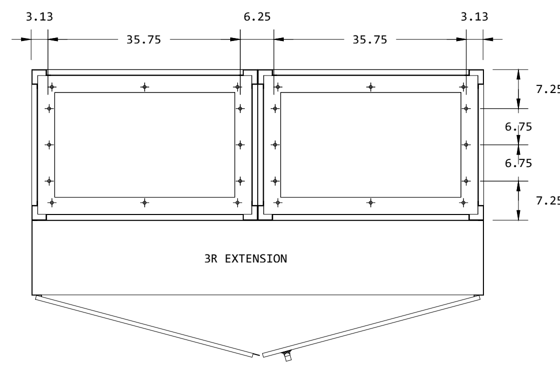


CABLE SCHEDULE

2	(2) 500MCM PER ϕ & N, (2) #1 OR 2/0 AWG GND
7	(1) #10AWG PER ϕ, N & GND



BASE PLAN - FRONT AND BACK ANCHORING OPTION



BASE PLAN - SIDES ANCHORING OPTION

Y:\T\~Tesla-ALL\TESLA_Superchargers\1_Washington_\3310 S Meridian St Puyallup, WA _1600A_16478

PLOT DATE: 11/24/2023 9:59 AM BY: ANHBUI

POWER & DISTRIBUTION
16450 PHOEBE AVENUE
LA MIRADA, CA 90638
PHONE: (714)-307-9198

CUSTOMER APPROVAL:

SITE NAME/LOCATION:
TESLA SUPERCHARGER
SERVICE SWBD "MDP-1"

3310 S MERIDIANT ST.
PUYALLUP, WA 98373

#	REVISION	DATE
0	ISSUED FOR APPROVAL	10/20/23

DRAWING: 2310-3-16478

SHEET DESCRIPTION: SLD/ ANCHORING LOCATIONS

DRAWN BY: AB	SHEET: 2
REV: 1	PAPER: 8.5"X 11"

6. FOUNDATION CALCULATIONS

PRCNC20231632

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: 2023345.09_Bloom_MCH000_Equip. Foundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES (c) ENERCALC INC 1983-2023

DESCRIPTION: CABINET FOUNDATION PAD

Code References

Calculations per ACI 318-19, IBC 2021, ASCE 7-16
Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	2,850.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	1.50 ksf
Soil Density	=	100.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	100.0 pcf
Soil/Concrete Friction Coeff.	=	0.350

Increases based on footing Depth

Footing base depth below soil surface	=	0.50 ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when max. length or width is greater than	=	ft

Dimensions

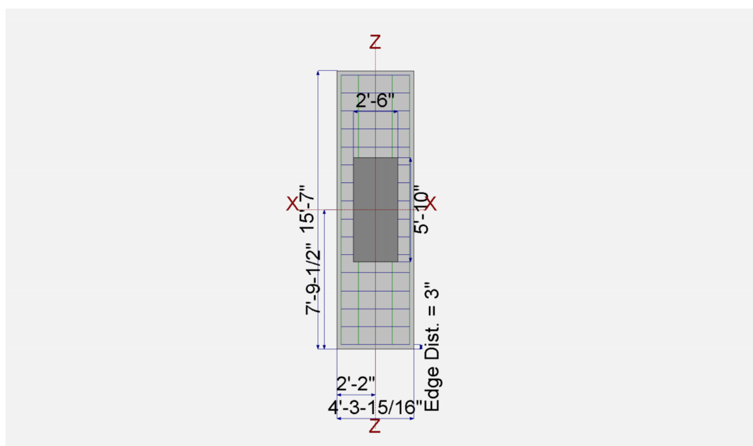
Width parallel to X-X Axis	=	4.330 ft
Length parallel to Z-Z Axis	=	15.583 ft
Footing Thickness	=	8.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	30.0 in
pz : parallel to Z-Z Axis	=	70.0 in
Height	=	0.010 in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.50 in



Reinforcing

Bars parallel to X-X Axis

Number of Bars	=	16
Reinforcing Bar Size	=	# 4

Bars parallel to Z-Z Axis

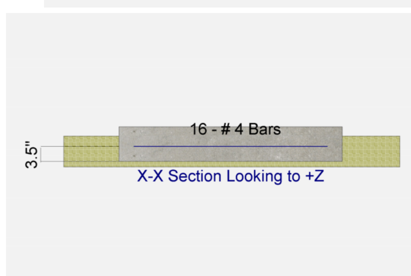
Number of Bars	=	5
Reinforcing Bar Size	=	# 4

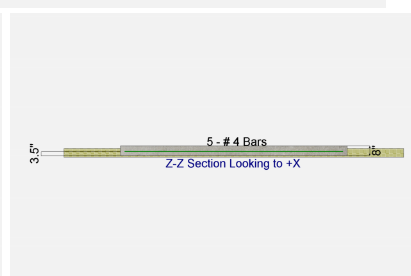
Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation

Bars along X-X Axis

# Bars required within zone	43.5 %
# Bars required on each side of zone	56.5 %





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	7.344							k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=					6.639	9.230		k-ft
V-x	=					1.780	2.475		k
V-z	=								k

General Footing

Project File: 2023345.09_Bloom_MCH000_Equip. Foundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES

DESCRIPTION: CABINET FOUNDATION PAD

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.2403	Soil Bearing	0.3604 ksf	1.50 ksf	+D-0.70E about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	2.365	Overturning - Z-Z	7.617 k-ft	18.013 k-ft	+0.60D+0.70E
PASS	1.793	Sliding - X-X	1.733 k	3.107 k	+0.60D+0.70E
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.06197	Z Flexure (+X)	0.2438 k-ft/ft	3.935 k-ft/ft	+1.402D+2.0E
PASS	0.06197	Z Flexure (-X)	0.2438 k-ft/ft	3.935 k-ft/ft	+1.402D-2.0E
PASS	0.4126	X Flexure (+Z)	1.813 k-ft/ft	4.394 k-ft/ft	+1.402D+2.0E
PASS	0.4126	X Flexure (-Z)	1.813 k-ft/ft	4.394 k-ft/ft	+1.402D+2.0E
PASS	0.1799	1-way Shear (+X)	5.716 psi	31.777 psi	+1.402D+2.0E
PASS	0.1799	1-way Shear (-X)	5.716 psi	31.777 psi	+1.402D-2.0E
PASS	0.1780	1-way Shear (+Z)	12.772 psi	71.759 psi	+1.402D+2.0E
PASS	0.1780	1-way Shear (-Z)	12.772 psi	71.759 psi	+1.402D+2.0E
PASS	0.08005	2-way Punching	8.482 psi	105.963 psi	+1.402D-2.0E

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +D+0.60W	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +D-0.60W	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +D+0.450W	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +D-0.450W	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +0.60D+0.60W	1.50	n/a	0.0	0.1233	0.1233	n/a	n/a	0.082
X-X, +0.60D-0.60W	1.50	n/a	0.0	0.1233	0.1233	n/a	n/a	0.082
X-X, +D+0.70E	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +D-0.70E	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +D+0.5250E	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +D-0.5250E	1.50	n/a	0.0	0.2055	0.2055	n/a	n/a	0.137
X-X, +0.60D+0.70E	1.50	n/a	0.0	0.1233	0.1233	n/a	n/a	0.082
X-X, +0.60D-0.70E	1.50	n/a	0.0	0.1233	0.1233	n/a	n/a	0.082
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.2055	0.2055	0.137
Z-Z, +D+0.60W	1.50	4.064	n/a	n/a	n/a	0.110	0.3010	0.201
Z-Z, +D-0.60W	1.50	-4.064	n/a	n/a	n/a	0.3010	0.110	0.201
Z-Z, +D+0.450W	1.50	3.048	n/a	n/a	n/a	0.1339	0.2771	0.185
Z-Z, +D-0.450W	1.50	-3.048	n/a	n/a	n/a	0.2771	0.1339	0.185
Z-Z, +0.60D+0.60W	1.50	6.774	n/a	n/a	n/a	0.02782	0.2188	0.146
Z-Z, +0.60D-0.60W	1.50	-6.774	n/a	n/a	n/a	0.2188	0.02782	0.146
Z-Z, +D+0.70E	1.50	6.592	n/a	n/a	n/a	0.05064	0.3604	0.240
Z-Z, +D-0.70E	1.50	-6.592	n/a	n/a	n/a	0.3604	0.05064	0.240
Z-Z, +D+0.5250E	1.50	4.944	n/a	n/a	n/a	0.08936	0.3217	0.215
Z-Z, +D-0.5250E	1.50	-4.944	n/a	n/a	n/a	0.3217	0.08936	0.215
Z-Z, +0.60D+0.70E	1.50	10.987	n/a	n/a	n/a	0.0	0.2832	0.189
Z-Z, +0.60D-0.70E	1.50	-10.987	n/a	n/a	n/a	0.2832	0.0	0.189

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, D Only	None	0.0 k-ft	Infinity	OK
X-X, +D+0.60W	None	0.0 k-ft	Infinity	OK
X-X, +D-0.60W	None	0.0 k-ft	Infinity	OK
X-X, +D+0.450W	None	0.0 k-ft	Infinity	OK
X-X, +D-0.450W	None	0.0 k-ft	Infinity	OK
X-X, +0.60D+0.60W	None	0.0 k-ft	Infinity	OK

General Footing

DESCRIPTION: CABINET FOUNDATION PAD

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, +0.60D-0.60W	None	0.0 k-ft	Infinity	OK
X-X, +D+0.70E	None	0.0 k-ft	Infinity	OK
X-X, +D-0.70E	None	0.0 k-ft	Infinity	OK
X-X, +D+0.5250E	None	0.0 k-ft	Infinity	OK
X-X, +D-0.5250E	None	0.0 k-ft	Infinity	OK
X-X, +0.60D+0.70E	None	0.0 k-ft	Infinity	OK
X-X, +0.60D-0.70E	None	0.0 k-ft	Infinity	OK
Z-Z, D Only	None	0.0 k-ft	Infinity	OK
Z-Z, +D+0.60W	4.696 k-ft	30.021 k-ft	6.393	OK
Z-Z, +D-0.60W	4.696 k-ft	30.021 k-ft	6.393	OK
Z-Z, +D+0.450W	3.522 k-ft	30.021 k-ft	8.523	OK
Z-Z, +D-0.450W	3.522 k-ft	30.021 k-ft	8.523	OK
Z-Z, +0.60D+0.60W	4.696 k-ft	18.013 k-ft	3.836	OK
Z-Z, +0.60D-0.60W	4.696 k-ft	18.013 k-ft	3.836	OK
Z-Z, +D+0.70E	7.617 k-ft	30.021 k-ft	3.941	OK
Z-Z, +D-0.70E	7.617 k-ft	30.021 k-ft	3.941	OK
Z-Z, +D+0.5250E	5.713 k-ft	30.021 k-ft	5.255	OK
Z-Z, +D-0.5250E	5.713 k-ft	30.021 k-ft	5.255	OK
Z-Z, +0.60D+0.70E	7.617 k-ft	18.013 k-ft	2.365	OK
Z-Z, +0.60D-0.70E	7.617 k-ft	18.013 k-ft	2.365	OK

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
X-X, D Only	0.0 k	5.048 k	No Sliding	OK
X-X, +D+0.60W	1.068 k	5.048 k	4.727	OK
X-X, +D-0.60W	-1.068 k	5.048 k	4.727	OK
X-X, +D+0.450W	0.8010 k	5.048 k	6.302	OK
X-X, +D-0.450W	-0.8010 k	5.048 k	6.302	OK
X-X, +0.60D+0.60W	1.068 k	3.107 k	2.909	OK
X-X, +0.60D-0.60W	-1.068 k	3.107 k	2.909	OK
X-X, +D+0.70E	1.733 k	5.048 k	2.914	OK
X-X, +D-0.70E	-1.733 k	5.048 k	2.914	OK
X-X, +D+0.5250E	1.299 k	5.048 k	3.885	OK
X-X, +D-0.5250E	-1.299 k	5.048 k	3.885	OK
X-X, +0.60D+0.70E	1.733 k	3.107 k	1.793	OK
X-X, +0.60D-0.70E	-1.733 k	3.107 k	1.793	OK
Z-Z, D Only	0.0 k	4.907 k	No Sliding	OK
Z-Z, +D+0.60W	0.0 k	4.907 k	No Sliding	OK
Z-Z, +D-0.60W	0.0 k	4.907 k	No Sliding	OK
Z-Z, +D+0.450W	0.0 k	4.907 k	No Sliding	OK
Z-Z, +D-0.450W	0.0 k	4.907 k	No Sliding	OK
Z-Z, +0.60D+0.60W	0.0 k	2.966 k	No Sliding	OK
Z-Z, +D+0.5250E	0.0 k	4.907 k	No Sliding	OK
Z-Z, +D-0.5250E	0.0 k	4.907 k	No Sliding	OK
Z-Z, +0.60D+0.70E	0.0 k	2.966 k	No Sliding	OK
Z-Z, +0.60D-0.70E	0.0 k	2.966 k	No Sliding	OK
Z-Z, +0.60D-0.60W	0.0 k	2.966 k	No Sliding	OK
Z-Z, +D+0.70E	0.0 k	4.907 k	No Sliding	OK
Z-Z, +D-0.70E	0.0 k	4.907 k	No Sliding	OK

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	1.810	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.40D	1.810	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D	1.552	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D	1.552	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D+0.50W	1.552	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D+0.50W	1.552	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D-0.50W	1.552	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D-0.50W	1.552	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK

General Footing

Project File: 2023345.09_Bloom_MCH000_Equip. Foundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES

DESCRIPTION: CABINET FOUNDATION PAD

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.20D+W	1.552	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D+W	1.552	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D-W	1.552	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.20D-W	1.552	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.90D+W	1.164	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.90D+W	1.164	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.90D-W	1.164	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.90D-W	1.164	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.402D+2.0E	1.813	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.402D+2.0E	1.813	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.402D-2.0E	1.813	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +1.402D-2.0E	1.813	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.6978D+2.0E	0.9024	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.6978D+2.0E	0.9024	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.6978D-2.0E	0.9024	+Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
X-X, +0.6978D-2.0E	0.9024	-Z	Bottom	0.1728	AsMin	0.2309	4.394	OK
Z-Z, +1.40D	0.06379	-X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.40D	0.06379	+X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D	0.05467	-X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D	0.05467	+X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D+0.50W	0.02577	-X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D+0.50W	0.08357	+X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D-0.50W	0.08357	-X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D-0.50W	0.02577	+X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D+W	0.003124	-X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +1.20D+W	0.1125	+X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D-W	0.1125	-X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.20D-W	0.003124	+X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +0.90D+W	0.01679	-X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +0.90D+W	0.09880	+X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +0.90D-W	0.09880	-X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +0.90D-W	0.01679	+X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +1.402D+2.0E	0.05674	-X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +1.402D+2.0E	0.2438	+X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.402D-2.0E	0.2438	-X	Bottom	0.1728	AsMin	0.2054	3.935	OK
Z-Z, +1.402D-2.0E	0.05674	+X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +0.6978D+2.0E	0.02824	-X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +0.6978D+2.0E	0.02824	+X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +0.6978D-2.0E	0.02824	-X	Top	0.1728	AsMin	0.2054	4.397	OK
Z-Z, +0.6978D-2.0E	0.02824	+X	Top	0.1728	AsMin	0.2054	4.397	OK

One Way Shear X

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	1.47 psi	1.47 psi	1.47 psi	31.78 psi	0.05	OK
+1.20D	1.26 psi	1.26 psi	1.26 psi	31.78 psi	0.04	OK
+1.20D+0.50W	0.58 psi	1.94 psi	1.94 psi	31.78 psi	0.06	OK
+1.20D-0.50W	1.94 psi	0.58 psi	1.94 psi	31.78 psi	0.06	OK
+1.20D+W	0.10 psi	2.62 psi	2.62 psi	31.78 psi	0.08	OK
+1.20D-W	2.62 psi	0.10 psi	2.62 psi	31.78 psi	0.08	OK
+0.90D+W	0.42 psi	2.30 psi	2.30 psi	31.78 psi	0.07	OK
+0.90D-W	2.30 psi	0.42 psi	2.30 psi	31.78 psi	0.07	OK
+1.402D+2.0E	1.30 psi	5.72 psi	5.72 psi	31.78 psi	0.18	OK
+1.402D-2.0E	5.72 psi	1.30 psi	5.72 psi	31.78 psi	0.18	OK
+0.6978D+2.0E	0.65 psi	0.65 psi	0.65 psi	31.78 psi	0.02	OK
+0.6978D-2.0E	0.65 psi	0.65 psi	0.65 psi	31.78 psi	0.02	OK

One Way Shear Z

Load Combination...	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	12.75 psi	12.75 psi	12.75 psi	71.76 psi	0.18	OK
+1.20D	10.93 psi	10.93 psi	10.93 psi	71.76 psi	0.15	OK
+1.20D+0.50W	10.93 psi	10.93 psi	10.93 psi	71.76 psi	0.15	OK
+1.20D-0.50W	10.93 psi	10.93 psi	10.93 psi	71.76 psi	0.15	OK
+1.20D+W	10.93 psi	10.93 psi	10.93 psi	71.76 psi	0.15	OK

PRCNC20231632

General Footing

Project File: 2023345.09_Bloom_MCH000_Equip. Foundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES

DESCRIPTION: CABINET FOUNDATION PAD

One Way Shear Z

Load Combination...	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.20D-W	10.93 psi	10.93 psi	10.93 psi	71.76 psi	0.15	OK
+0.90D+W	8.20 psi	8.20 psi	8.20 psi	71.76 psi	0.11	OK
+0.90D-W	8.20 psi	8.20 psi	8.20 psi	71.76 psi	0.11	OK
+1.402D+2.0E	12.77 psi	12.77 psi	12.77 psi	71.76 psi	0.18	OK
+1.402D-2.0E	12.77 psi	12.77 psi	12.77 psi	71.76 psi	0.18	OK
+0.6978D+2.0E	6.36 psi	6.36 psi	6.36 psi	71.76 psi	0.09	OK
+0.6978D-2.0E	6.36 psi	6.36 psi	6.36 psi	71.76 psi	0.09	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	7.71 psi	105.96 psi	0.0728	OK
+1.20D	6.61 psi	105.96 psi	0.0624	OK
+1.20D+0.50W	6.61 psi	105.96 psi	0.0624	OK
+1.20D-0.50W	6.61 psi	105.96 psi	0.0624	OK
+1.20D+W	6.61 psi	105.96 psi	0.0624	OK
+1.20D-W	6.61 psi	105.96 psi	0.0624	OK
+0.90D+W	4.96 psi	109.09 psi	0.04546	OK
+0.90D-W	4.96 psi	105.96 psi	0.0468	OK
+1.402D+2.0E	8.48 psi	109.09 psi	0.07775	OK
+1.402D-2.0E	8.48 psi	105.96 psi	0.08005	OK
+0.6978D+2.0E	3.85 psi	109.09 psi	0.03524	OK
+0.6978D-2.0E	3.85 psi	109.09 psi	0.03524	OK

PRCNC20231632

ASCE 7-16 Wind Calculations - Worst Case Scenario Alt Charging Post Wind reactions

Tesla Supercharging Station - Generic Site Calculations

Basic Wind Speed (Ultimate)	97	mph
Risk Category	II	
Exposure Category	c	
Topographic Category	1	
Z_g	900	ft
α	9.5	
K_{zmin}	0.85	
K_{zt}	1.00	

Component		Z (ft)	Vertical (in)	Horizontal (in)	Area (ft^2)		Kd	Kzt	Ke	Kz	qz	G	Cf	Horizontal Wind Force on Component (lb)	Resultant moment at base kip*ft
Signage		6.3	18	12	1.50		0.85	1.00	1.00	0.85	17.38	0.85	1.31	29.0	0.2
Sign - use last		5.3	6	12	0.50		0.85	1.00	1.00	0.85	17.38	0.85	1.30	9.6	0.050
Bollard 1		1.8	42	4	1.17		0.85	1.00	1.00	0.85	17.38	0.85	0.88	15.1	0.0
ALT Post		3.2	76.6	26.77	14.30		0.85	1.00	1.00	0.85	17.38	0.85	1.33	281.2	0.9
Total:														**334.9**	**1.156**

PRCNC20231632

Mat Foundation Analysis

General Info	
Code	ASCE 7-16
Concrete Code	ACI 318-14
Seismic Design Category	D
Bearing On	Soil
Foundation Type	Pad
Reinforcing Known	Yes
Max Bearing Capacity	100%
Max Overturning Capacity	100%

Reactions	
Moment, M	1.156 k-ft
Axial, P	0.2 k
Shear, V	0.3349 k

Pad & Pier Geometry	
Pier N/A	
Pad Length, L [y]	2 ft
Pad Width, W [x]	4.67 ft
Pad Thickness, t	1.75 ft
Depth, D	1.75 ft
Height Above Grade, HG	0 ft
Centroid, X	2.335 ft
Centroid, Y	1 ft
Eccentricity	0.0000 ft

Pad & Pier Reinforcing		
Rebar Fy	60 ksi	
Concrete F'c	2.5 ksi	
Pad Reinforcing Clear Cover	3 in	
Reinforced Top & Bottom?	Yes	
Top and Bot. Reinf. Different?	No	
Direction of Reinforcing	L	W
Pad Reinforcing Size	# 4	# 4
Pad Quantity Per Layer	2	6

Soil Properties	
Soil Type	Granular
Soil Unit Weight	100 pcf
Angle of Friction, ø	19.47
Base Friction Coefficient, µ	0.35
Bearing Type	Gross
Ultimate Bearing	3 ksf
Water Table Depth	10 ft
Neglected Depth	0.5 ft

GPD Mat Foundation Analysis - V4.4

Bearing Summary

Case	*Demand/Limits*	*Capacity/Availability*	*Check*	*Eccentricity*	*Load Case*
Qxmax	0.76 ksf	2.25 ksf	OK, <= 105%	L/3.0	0.9D+1.0W
Qymax	0.48 ksf	2.25 ksf	OK, <= 105%	W/9.3	1.2D+1.0W
Qmax @ 45°	0.61 ksf	2.25 ksf	OK, <= 105%	L/5.7	1.2D+1.0W
Controlling Capacity		**33.7%**	**Pass**		

Overturning Summary

Case	*Demand/Limits*	*Capacity/Availability*	*Check*		*Load Case*
Ovtx	1.6 k-ft	3.1 k-ft	66.7%	OK	0.9D+1.0W
Ovty	1.6 k-ft	7.3 k-ft	28.6%	OK	0.9D+1.0W
Ovtxy	1.1 k-ft	3.1 k-ft	47.2%	OK	0.9D+1.0W
Controlling Capacity		**66.7%**	**Pass**		

Sliding Summary

Case	*Demand/Limits*	*Capacity/Availability*	*Check*		*Load Case*
Slidingx	0.3 k	1.6 k	20.9%	OK	0.9D+1.0W
Slidingy	0.3 k	1.0 k	32.2%	OK	0.9D+1.0W
Controlling Capacity		**32.2%**	**Pass**		

Reinforcement Summary

Component	*Demand/Limits*	*Capacity/Availability*	*Check*		*Load Case*
Pad Flexural Bending	0.9 k-ft	30.6 k-ft	2.9%	OK	1.2D+1.0W
One-Way Shear in Pad	0.4 k	31.1 k	1.1%	OK	1.2D+1.0W
Two-Way Shear in Pad	1.2 k	178.5 k	0.7%	OK	0.9D+1.0W
As Min Pad Met?	0.40 sq. in.	0.03 sq. in.	Yes		
Controlling Capacity		**2.9%**	**Pass**		

Section 1806 Presumptive Load-Bearing Values of Soils

1806.1 Load combinations

The presumptive load-bearing values provided in Table 1806.2 shall be used with the allowable stress design load combinations specified in Section 1605.3. The values of vertical foundation pressure and lateral bearing pressure given in Table 1806.2 shall be permitted to be increased by one-third where used with the alternative basic load combinations of Section 1605.3.2 that include wind or earthquake loads.

TABLE 1806.2

PRESUMPTIVE LOAD-BEARING VALUES

CLASS OF MATERIALS	VERTICAL FOUNDATION PRESSURE (psf)	LATERAL BEARING PRESSURE (psf/ft below natural grade)	LATERAL SLIDING RESISTANCE	
			Coefficient of friction[a]	Cohesion (psf)[b]
1. Crystalline bedrock	12,000	1,200	0.70	—
2. Sedimentary and foliated rock	4,000	400	0.35	—
3. Sandy gravel and/or gravel (GW and GP)	3,000	200	0.35	—
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	—
5. Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500	100	—	130

For SI: 1 pound per square foot = 0.0479kPa, 1 pound per square foot per foot = 0.157 kPa/m.

a. Coefficient to be multiplied by the dead load.

b. Cohesion value to be multiplied by the contact area, as limited by Section 1806.3.2.

SOIL CALCULATIONS TO DETERMINE EQUIVALENT FRICTION ANGLE (ø) BASED ON PROVIDED LATERAL BEARING PRESSURE VALUES FROM TABLE 1806.2.

PER TABLE 1806.2 ALLOWABLE LATERAL BEARING PRESSURE FOR CLASS 5 MATERIAL (ASSUMED WORST CASE) = 100 PSF/FT

Passive Lateral Earth Pressure, σp = Kp x σv'

Kp = σp / σv = lateral earth pressure / vertical effective pressure

σp, lateral earth pressure (assuming Factor of Safety = 2) = 100psf/ft * 2 = 200psf/ft
σv, vertical effective pressure = assumed soil unit weight = assumed value of 100 psf/ft

Kp = σp / σv = 200psf/ft / 100psf/ft = 2.0

Rankine Theory where B = 0:

Kp = tan^2 (45 + ø/2)

2.0 = tan^2 (45 + ø/2)

ø = 19.4712

PRCNC20231632

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: FOundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES

DESCRIPTION: SWITCHGEAR FOUNDATION PAD

Code References

Calculations per ACI 318-19, IBC 2021, ASCE 7-16
Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	2,850.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=		
Min Allow % Temp Reinf.	=	0.00180	
Min. Overturning Safety Factor	=	1.0	: 1
Min. Sliding Safety Factor	=	1.0	: 1
Add Ftg Wt for Soil Pressure	:	Yes	
Use ftg wt for stability, moments & shears	:	Yes	
Add Pedestal Wt for Soil Pressure	:	No	
Use Pedestal wt for stability, mom & shear	:	No	

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	100.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	100.0	pcf
Soil/Concrete Friction Coeff.	=	0.350	

Increases based on footing Depth

Footing base depth below soil surface	=	0.50	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=		ksf
when max. length or width is greater than	=		ft

Dimensions

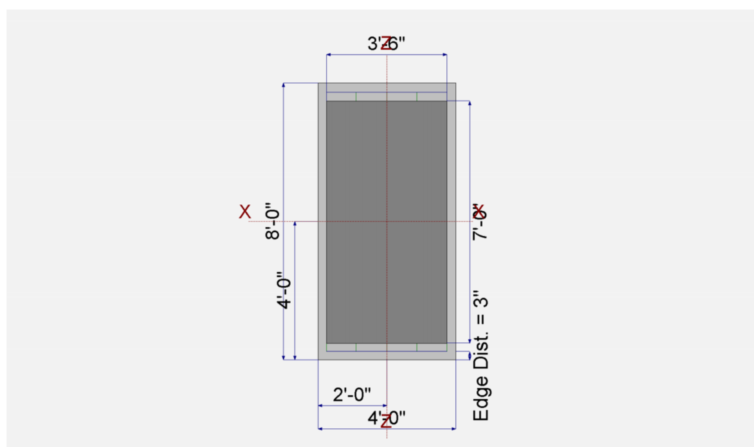
Width parallel to X-X Axis	=	4.0	ft
Length parallel to Z-Z Axis	=	8.0	ft
Footing Thickness	=	8.0	in

Pedestal dimensions...

px : parallel to X-X Axis	=	42.0	in
pz : parallel to Z-Z Axis	=	84.0	in
Height	=	0.010	in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.50	in



Reinforcing

Bars parallel to X-X Axis

Number of Bars	=		9.0
Reinforcing Bar Size	=	#	4

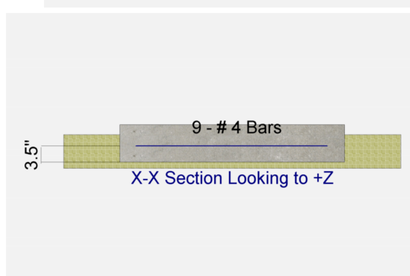
Bars parallel to Z-Z Axis

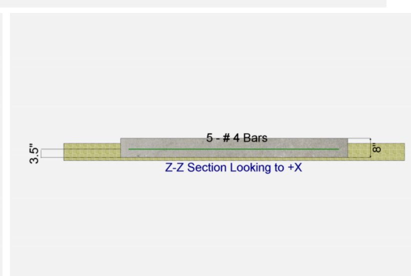
Number of Bars	=		5.0
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation

	Bars along X-X Axis
# Bars required within zone	66.7 %
# Bars required on each side of zone	33.3 %





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	2.60							k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=					3.784	3.286		k-ft
V-x	=					1.009	0.8762		k
V-z	=								k

PRCNC20231632

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: FOundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES

DESCRIPTION: SWITCHGEAR FOUNDATION PAD

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.2025	Soil Bearing	0.3037 ksf	1.50 ksf	+D-0.70E about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	2.521	Overturning - Z-Z	2.710 k-ft	6.832 k-ft	+0.60D+0.70E
PASS	2.112	Sliding - X-X	0.6133 k	1.296 k	+0.60D+0.70E
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.02229	Z Flexure (+X)	0.09560 k-ft/ft	4.288 k-ft/ft	+0.6978D+2.0E
PASS	0.02229	Z Flexure (-X)	0.09560 k-ft/ft	4.288 k-ft/ft	+0.6978D-2.0E
PASS	0.003005	X Flexure (+Z)	0.01422 k-ft/ft	4.732 k-ft/ft	+1.402D-2.0E
PASS	0.003005	X Flexure (-Z)	0.01422 k-ft/ft	4.732 k-ft/ft	+1.402D+2.0E
PASS	n/a	1-way Shear (+X)	0.0 psi	39.685 psi	n/a
PASS	0.0	1-way Shear (-X)	0.0 psi	0.0 psi	n/a
PASS	0.005550	1-way Shear (+Z)	0.3376 psi	60.822 psi	+1.402D+2.0E
PASS	0.005550	1-way Shear (-Z)	0.3376 psi	60.822 psi	+1.402D+2.0E
PASS	n/a	2-way Punching	3.057 psi	39.685 psi	+0.6978D-2.0E

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +D+0.60W	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +D-0.60W	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +D+0.450W	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +D-0.450W	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +0.60D+0.60W	1.50	n/a	0.0	0.1068	0.1068	n/a	n/a	0.071
X-X, +0.60D-0.60W	1.50	n/a	0.0	0.1068	0.1068	n/a	n/a	0.071
X-X, +D+0.70E	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +D-0.70E	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +D+0.5250E	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +D-0.5250E	1.50	n/a	0.0	0.1779	0.1779	n/a	n/a	0.119
X-X, +0.60D+0.70E	1.50	n/a	0.0	0.1068	0.1068	n/a	n/a	0.071
X-X, +0.60D-0.70E	1.50	n/a	0.0	0.1068	0.1068	n/a	n/a	0.071
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.1779	0.1779	0.119
Z-Z, +D+0.60W	1.50	5.637	n/a	n/a	n/a	0.05380	0.3020	0.201
Z-Z, +D-0.60W	1.50	-5.637	n/a	n/a	n/a	0.3020	0.05380	0.201
Z-Z, +D+0.450W	1.50	4.228	n/a	n/a	n/a	0.08483	0.2710	0.181
Z-Z, +D-0.450W	1.50	-4.228	n/a	n/a	n/a	0.2710	0.08483	0.181
Z-Z, +0.60D+0.60W	1.50	9.395	n/a	n/a	n/a	0.0	0.2326	0.155
Z-Z, +0.60D-0.60W	1.50	-9.395	n/a	n/a	n/a	0.2326	0.0	0.155
Z-Z, +D+0.70E	1.50	5.711	n/a	n/a	n/a	0.05217	0.3037	0.203
Z-Z, +D-0.70E	1.50	-5.711	n/a	n/a	n/a	0.3037	0.05217	0.203
Z-Z, +D+0.5250E	1.50	4.283	n/a	n/a	n/a	0.08361	0.2722	0.182
Z-Z, +D-0.5250E	1.50	-4.283	n/a	n/a	n/a	0.2722	0.08361	0.182
Z-Z, +0.60D+0.70E	1.50	9.519	n/a	n/a	n/a	0.0	0.2346	0.156
Z-Z, +0.60D-0.70E	1.50	-9.519	n/a	n/a	n/a	0.2346	0.0	0.156

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, D Only	None	0.0 k-ft	Infinity	OK
X-X, +D+0.60W	None	0.0 k-ft	Infinity	OK
X-X, +D-0.60W	None	0.0 k-ft	Infinity	OK
X-X, +D+0.450W	None	0.0 k-ft	Infinity	OK
X-X, +D-0.450W	None	0.0 k-ft	Infinity	OK
X-X, +0.60D+0.60W	None	0.0 k-ft	Infinity	OK

General Footing

DESCRIPTION: SWITCHGEAR FOUNDATION PAD

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, +0.60D-0.60W	None	0.0 k-ft	Infinity	OK
X-X, +D+0.70E	None	0.0 k-ft	Infinity	OK
X-X, +D-0.70E	None	0.0 k-ft	Infinity	OK
X-X, +D+0.5250E	None	0.0 k-ft	Infinity	OK
X-X, +D-0.5250E	None	0.0 k-ft	Infinity	OK
X-X, +0.60D+0.70E	None	0.0 k-ft	Infinity	OK
X-X, +0.60D-0.70E	None	0.0 k-ft	Infinity	OK
Z-Z, D Only	None	0.0 k-ft	Infinity	OK
Z-Z, +D+0.60W	2.675 k-ft	11.387 k-ft	4.257	OK
Z-Z, +D-0.60W	2.675 k-ft	11.387 k-ft	4.257	OK
Z-Z, +D+0.450W	2.006 k-ft	11.387 k-ft	5.677	OK
Z-Z, +D-0.450W	2.006 k-ft	11.387 k-ft	5.677	OK
Z-Z, +0.60D+0.60W	2.675 k-ft	6.832 k-ft	2.554	OK
Z-Z, +0.60D-0.60W	2.675 k-ft	6.832 k-ft	2.554	OK
Z-Z, +D+0.70E	2.710 k-ft	11.387 k-ft	4.202	OK
Z-Z, +D-0.70E	2.710 k-ft	11.387 k-ft	4.202	OK
Z-Z, +D+0.5250E	2.032 k-ft	11.387 k-ft	5.603	OK
Z-Z, +D-0.5250E	2.032 k-ft	11.387 k-ft	5.603	OK
Z-Z, +0.60D+0.70E	2.710 k-ft	6.832 k-ft	2.521	OK
Z-Z, +0.60D-0.70E	2.710 k-ft	6.832 k-ft	2.521	OK

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
X-X, D Only	0.0 k	2.093 k	No Sliding	OK
X-X, +D+0.60W	0.6054 k	2.093 k	3.457	OK
X-X, +D-0.60W	-0.6054 k	2.093 k	3.457	OK
X-X, +D+0.450W	0.4541 k	2.093 k	4.609	OK
X-X, +D-0.450W	-0.4541 k	2.093 k	4.609	OK
X-X, +0.60D+0.60W	0.6054 k	1.296 k	2.140	OK
X-X, +0.60D-0.60W	-0.6054 k	1.296 k	2.140	OK
X-X, +D+0.70E	0.6133 k	2.093 k	3.412	OK
X-X, +D-0.70E	-0.6133 k	2.093 k	3.412	OK
X-X, +D+0.5250E	0.460 k	2.093 k	4.549	OK
X-X, +D-0.5250E	-0.460 k	2.093 k	4.549	OK
X-X, +0.60D+0.70E	0.6133 k	1.296 k	2.112	OK
X-X, +0.60D-0.70E	-0.6133 k	1.296 k	2.112	OK
Z-Z, D Only	0.0 k	2.043 k	No Sliding	OK
Z-Z, +D+0.60W	0.0 k	2.043 k	No Sliding	OK
Z-Z, +D-0.60W	0.0 k	2.043 k	No Sliding	OK
Z-Z, +D+0.450W	0.0 k	2.043 k	No Sliding	OK
Z-Z, +D-0.450W	0.0 k	2.043 k	No Sliding	OK
Z-Z, +0.60D+0.60W	0.0 k	1.246 k	No Sliding	OK
Z-Z, +D+0.5250E	0.0 k	2.043 k	No Sliding	OK
Z-Z, +D-0.5250E	0.0 k	2.043 k	No Sliding	OK
Z-Z, +0.60D+0.70E	0.0 k	1.246 k	No Sliding	OK
Z-Z, +0.60D-0.70E	0.0 k	1.246 k	No Sliding	OK
Z-Z, +0.60D-0.60W	0.0 k	1.246 k	No Sliding	OK
Z-Z, +D+0.70E	0.0 k	2.043 k	No Sliding	OK
Z-Z, +D-0.70E	0.0 k	2.043 k	No Sliding	OK

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.01420	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.40D	0.01420	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D	0.01217	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D	0.01217	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D+0.50W	0.01217	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D+0.50W	0.01217	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D-0.50W	0.01217	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D-0.50W	0.01217	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK

General Footing

Project File: FOundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES

DESCRIPTION: SWITCHGEAR FOUNDATION PAD

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.20D+W	0.01217	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D+W	0.01217	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D-W	0.01217	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.20D-W	0.01217	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.90D+W	0.009126	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.90D+W	0.009126	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.90D-W	0.009126	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.90D-W	0.009126	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.402D+2.0E	0.01422	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.402D+2.0E	0.01422	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.402D-2.0E	0.01422	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +1.402D-2.0E	0.01422	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.6978D+2.0E	0.007076	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.6978D+2.0E	0.007076	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.6978D-2.0E	0.007076	+Z	Bottom	0.1728	AsMin	0.250	4.732	OK
X-X, +0.6978D-2.0E	0.007076	-Z	Bottom	0.1728	AsMin	0.250	4.732	OK
Z-Z, +1.40D	0.003549	-X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.40D	0.003549	+X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.20D	0.003042	-X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.20D	0.003042	+X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.20D+0.50W	.000080	-X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +1.20D+0.50W	0.006164	+X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.20D-0.50W	0.006164	-X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.20D-0.50W	.000080	+X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +1.20D+W	0.003203	-X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +1.20D+W	0.009287	+X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.20D-W	0.009287	-X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.20D-W	0.003203	+X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +0.90D+W	0.002714	-X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +0.90D+W	0.008782	+X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +0.90D-W	0.008782	-X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +0.90D-W	0.002714	+X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +1.402D+2.0E	0.004229	-X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +1.402D+2.0E	0.01537	+X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.402D-2.0E	0.01537	-X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +1.402D-2.0E	0.004229	+X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +0.6978D+2.0E	0.002105	-X	Top	0.1728	AsMin	0.2250	4.794	OK
Z-Z, +0.6978D+2.0E	0.09560	+X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +0.6978D-2.0E	0.09560	-X	Bottom	0.1728	AsMin	0.2250	4.288	OK
Z-Z, +0.6978D-2.0E	0.002105	+X	Top	0.1728	AsMin	0.2250	4.794	OK

One Way Shear X

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+1.20D	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+1.20D+0.50W	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+1.20D-0.50W	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+1.20D+W	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+1.20D-W	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+0.90D+W	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+0.90D-W	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+1.402D+2.0E	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+1.402D-2.0E	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+0.6978D+2.0E	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK
+0.6978D-2.0E	0.00 psi	0.00 psi	0.00 psi	39.69 psi	0.00	OK

One Way Shear Z

Load Combination...	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.34 psi	0.34 psi	0.34 psi	60.82 psi	0.01	OK
+1.20D	0.29 psi	0.29 psi	0.29 psi	60.82 psi	0.00	OK
+1.20D+0.50W	0.29 psi	0.29 psi	0.29 psi	60.82 psi	0.00	OK
+1.20D-0.50W	0.29 psi	0.29 psi	0.29 psi	60.82 psi	0.00	OK
+1.20D+W	0.29 psi	0.29 psi	0.29 psi	60.82 psi	0.00	OK

PRCNC20231632

General Footing

Project File: FOundation Calcs.ec6

LIC# : KW-06016111, Build:20.23.10.31 GPD ASSOCIATES

DESCRIPTION: SWITCHGEAR FOUNDATION PAD

One Way Shear Z

Load Combination...	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.20D-W	0.29 psi	0.29 psi	0.29 psi	60.82 psi	0.00	OK
+0.90D+W	0.22 psi	0.22 psi	0.22 psi	60.82 psi	0.00	OK
+0.90D-W	0.22 psi	0.22 psi	0.22 psi	60.82 psi	0.00	OK
+1.402D+2.0E	0.34 psi	0.34 psi	0.34 psi	60.82 psi	0.01	OK
+1.402D-2.0E	0.34 psi	0.34 psi	0.34 psi	60.82 psi	0.01	OK
+0.6978D+2.0E	0.17 psi	0.17 psi	0.17 psi	60.82 psi	0.00	OK
+0.6978D-2.0E	0.17 psi	0.17 psi	0.17 psi	60.82 psi	0.00	OK

Two-Way "Punching" Shear

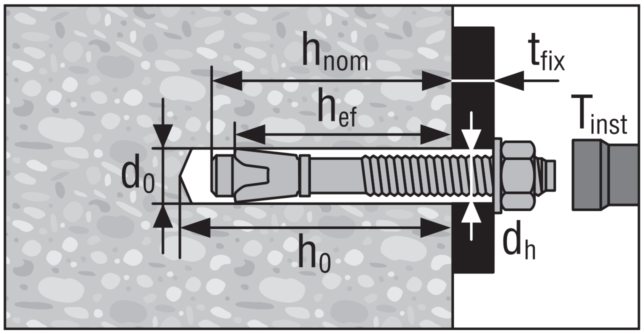
All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	0.35 psi	100.00 psi	0.003499	OK
+1.20D	0.30 psi	100.00 psi	0.002999	OK
+1.20D+0.50W	0.30 psi	100.00 psi	0.002999	OK
+1.20D-0.50W	0.30 psi	100.00 psi	0.002999	OK
+1.20D+W	0.30 psi	102.57 psi	0.002924	OK
+1.20D-W	0.30 psi	100.00 psi	0.002999	OK
+0.90D+W	0.27 psi	102.57 psi	0.002673	OK
+0.90D-W	0.27 psi	100.00 psi	0.002742	OK
+1.402D+2.0E	0.48 psi	102.57 psi	0.004699	OK
+1.402D-2.0E	0.48 psi	100.00 psi	0.00482	OK
+0.6978D+2.0E	3.06 psi	102.57 psi	0.02981	OK
+0.6978D-2.0E	3.06 psi	100.00 psi	0.03057	OK

7. HILTI REFERENCE DOCUMENTATION

PRCNC20231632

Figure 1 — Hilti KWIK Bolt TZ 2 specifications



DESIGN INFORMATION IN CONCRETE PER ACI 318

ACI 318 Chapter 17 Design

The load values contained in this section are Hilti Simplified Design Tables. The load tables in this section were developed using the Strength Design parameters and variables of ICC-ES ESR-4266 and the equations within ACI 318 Chapter 17. For a detailed explanation of the Hilti Simplified Design Tables refer to section 3.1.8. Data tables from ESR-4266 are not contained in this section but can be found at www.icc-es.org or at www.hilti.com

Table 2 — Hilti Carbon Steel KB-TZ2 design strength based on concrete failure modes in uncracked concrete per ACI 318 Ch. 17, applicable for both hammer and core drilled installations [1,2,3,4]

Nominal anchor diameter in.	Effective embedment in. (mm)	Nominal embedment in. (mm)	Tension (lesser of concrete breakout / pullout) - ΦN_n				Shear (lesser of concrete breakout or pryout) - ΦV_n			
			f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)
1/4	1-1/2 (38)	1 3/4 (44)	945 (4.2)	980 (4.4)	1,040 (4.6)	1,125 (5.0)	1,545 (6.9)	1,690 (7.5)	1,950 (8.7)	2,390 (10.6)
3/8	1-1/2 (38)	1 7/8 (48)	1,435 (6.4)	1,570 (7.0)	1,815 (8.1)	2,220 (9.9)	1,545 (6.9)	1,690 (7.5)	1,950 (8.7)	2,390 (10.6)
	2 (51)	2 1/2 (64)	2,205 (9.8)	2,415 (10.7)	2,790 (12.4)	3,420 (15.2)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	2-1/2 (64)	3 (76)	2,715 (12.1)	2,895 (12.9)	3,205 (14.3)	3,690 (16.4)	6,640 (29.5)	7,275 (32.4)	8,400 (37.4)	10,290 (45.8)
1/2	1-1/2 (38)	2 (51)	1,610 (7.2)	1,765 (7.9)	2,040 (9.1)	2,495 (11.1)	1,735 (7.7)	1,900 (8.5)	2,195 (9.8)	2,690 (12.0)
	2 (51)	2 1/2 (64)	2,480 (11.0)	2,720 (12.1)	3,140 (14.0)	3,845 (17.1)	2,675 (11.9)	2,930 (13.0)	3,380 (15.0)	4,140 (18.4)
	2-1/2 (64)	3 (76)	3,085 (13.7)	3,375 (15.0)	3,900 (17.3)	4,775 (21.2)	6,640 (29.5)	7,275 (32.4)	8,400 (37.4)	10,290 (45.8)
	3-1/4 (83)	3 3/4 (95)	4,570 (20.3)	5,005 (22.3)	5,780 (25.7)	7,080 (31.5)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
5/8	2-3/4 (70)	3 1/4 (83)	3,495 (15.5)	3,830 (17.0)	4,425 (19.7)	5,420 (24.1)	7,660 (34.1)	8,395 (37.3)	9,690 (43.1)	11,870 (52.8)
	3-1/4 (83)	3 3/4 (95)	4,570 (20.3)	5,005 (22.3)	5,780 (25.7)	7,080 (31.5)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
	4 (102)	4 1/2 (114)	5,845 (26.0)	6,405 (28.5)	7,395 (32.9)	9,060 (40.3)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
3/4	3-1/4 (83)	4 (102)	5,140 (22.9)	5,630 (25.0)	6,505 (28.9)	7,965 (35.4)	11,075 (49.3)	12,130 (54.0)	14,005 (62.3)	17,155 (76.3)
	3-3/4[5] (95)	4 1/2 (114)	6,370 (28.3)	6,980 (31.0)	8,060 (35.9)	9,870 (43.9)	13,725 (61.1)	15,035 (66.9)	17,360 (77.2)	21,265 (94.6)
	4-3/4 (121)	5 1/2 (140)	8,075 (35.9)	8,845 (39.3)	10,215 (45.4)	12,510 (55.6)	17,390 (77.4)	19,050 (84.7)	22,000 (97.9)	26,945 (119.9)
1	4 (102)	4 5/8 (117)	7,020 (31.2)	7,690 (34.2)	8,880 (39.5)	10,875 (48.4)	15,120 (67.3)	16,565 (73.7)	19,125 (85.1)	23,425 (104.2)
	5-3/4 (146)	6 3/8 (162)	10,755 (47.8)	11,780 (52.4)	13,605 (60.5)	16,660 (74.1)	23,165 (103.0)	25,375 (112.9)	29,300 (130.3)	35,885 (159.6)

1 See Section 3.1.8 to convert design strength value to ASD value.
2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
3 Apply spacing, edge distance, and concrete thickness factors in tables 6 to 15 as necessary. Compare to the steel values in table 4. The lesser of the values is to be used for the design.
4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60.
5 For core drilled installations of 3/4" anchors installed at 3-3/4" effective embedment, apply a reduction factor of 0.89 to the design tension strength.

Table 3 — Hilti Carbon Steel KB-TZ2 design strength based on concrete failure modes in cracked concrete per ACI 318 Ch. 17, applicable for both hammer and core drilled installations [1,2,3,4,5]

Nominal anchor diameter in.	Effective embedment in. (mm)	Nominal embedment in. (mm)	Tension (lesser of concrete breakout / pullout) - ΦN_n				Shear (lesser of concrete breakout or pryout) - ΦV_n			
			f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.1 MPa) lb (kN)
1/4	1-1/2 (38)	1 3/4 (44)	280 (1.2)	300 (1.3)	340 (1.5)	395 (1.8)	1,095 (4.9)	1,195 (5.3)	1,385 (6.2)	1,695 (7.5)
3/8	1-1/2 (38)	1 7/8 (48)	1,255 (5.6)	1,375 (6.1)	1,585 (7.1)	1,940 (8.6)	1,350 (6.0)	1,480 (6.6)	1,710 (7.6)	2,090 (9.3)
	2 (51)	2 1/2 (64)	1,930 (8.6)	2,115 (9.4)	2,440 (10.9)	2,990 (13.3)	2,080 (9.3)	2,275 (10.1)	2,630 (11.7)	3,220 (14.3)
	2-1/2 (64)	3 (76)	2,185 (9.7)	2,390 (10.6)	2,765 (12.3)	3,385 (15.1)	4,705 (20.9)	5,155 (22.9)	5,950 (26.5)	7,285 (32.4)
1/2	1-1/2 (38)	2 (51)	1,435 (6.4)	1,570 (7.0)	1,815 (8.1)	2,220 (9.9)	1,545 (6.9)	1,690 (7.5)	1,950 (8.7)	2,390 (10.6)
	2 (51)	2 1/2 (64)	1,930 (8.6)	2,115 (9.4)	2,440 (10.9)	2,990 (13.3)	2,080 (9.3)	2,275 (10.1)	2,630 (11.7)	3,220 (14.3)
	2-1/2 (64)	3 (76)	2,700 (12.0)	2,955 (13.1)	3,415 (15.2)	4,180 (18.6)	5,810 (25.8)	6,365 (28.3)	7,350 (32.7)	9,000 (40.0)
	3-1/4 (83)	3 3/4 (95)	3,235 (14.4)	3,545 (15.8)	4,095 (18.2)	5,015 (22.3)	6,970 (31.0)	7,640 (34.0)	8,820 (39.2)	10,800 (48.0)
5/8	2-3/4 (70)	3 1/4 (83)	3,110 (13.8)	3,410 (15.2)	3,935 (17.5)	4,820 (21.4)	6,705 (29.8)	7,345 (32.7)	8,480 (37.7)	10,385 (46.2)
	3-1/4 (83)	3 3/4 (95)	4,000 (17.8)	4,380 (19.5)	5,060 (22.5)	6,195 (27.6)	8,615 (38.3)	9,435 (42.0)	10,895 (48.5)	13,345 (59.4)
	4 (102)	4 1/2 (114)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
3/4	3-1/4 (83)	4 (102)	4,000 (17.8)	4,380 (19.5)	5,060 (22.5)	6,195 (27.6)	8,615 (38.3)	9,435 (42.0)	10,895 (48.5)	13,345 (59.4)
	3-3/4 (95)	4 1/2 (114)	4,955 (22.0)	5,430 (24.2)	6,270 (27.9)	7,680 (34.2)	10,675 (47.5)	11,695 (52.0)	13,505 (60.1)	16,540 (73.6)
	4-3/4 (121)	5 1/2 (140)	5,745 (25.6)	6,055 (26.9)	6,580 (29.3)	7,405 (32.9)	15,220 (67.7)	16,670 (74.2)	19,250 (85.6)	23,575 (104.9)
1	4 (102)	4 5/8 (117)	5,460 (24.3)	5,980 (26.6)	6,905 (30.7)	8,460 (37.6)	11,760 (52.3)	12,880 (57.3)	14,875 (66.2)	18,220 (81.0)
	5-3/4 (146)	6 3/8 (162)	7,675 (34.1)	8,410 (37.4)	9,710 (43.2)	11,890 (52.9)	20,270 (90.2)	22,205 (98.8)	25,640 (114.1)	31,400 (139.7)

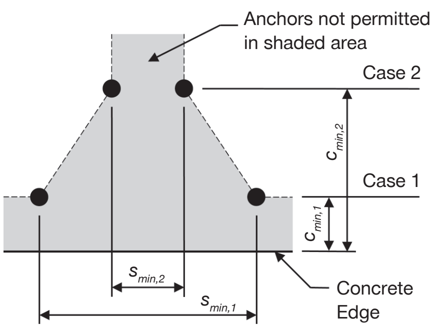
1 See Section 3.1.8 to convert design strength value to ASD value.
2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
3 Apply spacing, edge distance, and concrete thickness factors in tables 6 to 17 as necessary. Compare to the steel values in table 4. The lesser of the values is to be used for the design.
4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60.
5 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic tension loads, multiply cracked concrete tabular values in tension only by $\alpha_{N,seis}$ = 0.75, except for 3/4 x 4-3/4 h_{ef} where $\alpha_{N,seis}$ = 0.73. No reduction needed for seismic shear. See Section 3.1.8 for additional information on seismic applications.

Table 20 — Hilti Stainless Steel KB-TZ2 design strength based on steel failure per ACI 318 Ch. 17 [1,2]

Nominal anchor diameter in.	Effective embedment depth in. (mm)			Tensile [3] ϕN_{sa} lb (kN)	Shear [4] ϕV_{sa} lb (kN)	Seismic Shear [5] ϕV_{sa} lb (kN)
1/4	1-1/2 (38)			2,190 (9.7)	950 (4.2)	720 (3.2)
3/8	1-1/2 (38)			4,635 (20.6)	3,000 (13.3)	3,000 (13.3)
3/8	2 (51)		2-1/2 (64)	4,635 (20.6)	3,175 (14.1)	3,175 (14.1)
1/2	2 (51)	2-1/2 (64)	3-1/4 (83)	8,905 (39.6)	5,425 (24.1)	5,425 (24.1)
5/8	2-3/4 (70)	3-1/4 (83)	4 (102)	14,125 (62.8)	8,030 (35.7)	8,030 (35.7)
3/4	3-1/4 (83)	3-3/4 (95)	4-3/4 (121)	18,035 (80.2)	10,765 (47.9)	8,755 (38.9)
1 (25.4)	4 (102)			35,215 (156.6)	14,920 (66.4)	8,755 (38.9)
1 (25.4)	5-3/4 (146)			35,215 (156.6)	20,410 (90.8)	8,755 (38.9)

1 See Section 3.1.8 to convert design strength value to ASD value.
2 Hilti KB-TZ2 stainless steel anchors are to be considered ductile steel elements.
3 Tensile $\phi N_{sa} = \phi A_{se,N} f_{uta}$ as noted in ACI 318 Ch. 17.
4 Shear values determined by static shear tests with $\phi V_{sa} < \phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Ch. 17.
5 Seismic shear values determined by seismic shear tests with $\phi V_{sa} \leq \phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Ch. 17.
See Section 3.1.8 for additional information on seismic applications.

Figure 3



For a specific edge distance, the permitted spacing is calculated as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}(c - c_{min,2})$$

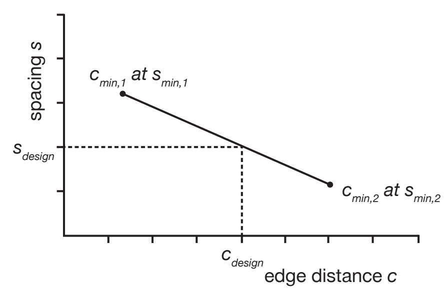


Table 21 — Hilti KB-TZ2 stainless steel installation parameters[1]

Setting information	Symbol	Units	Nominal Anchor diameter (in.)														
			1/4	3/8			1/2			5/8			3/4			1	
Effective embedment	h_{ef}	in.	1-1/2	1-1/2	2	2-1/2	2	2-1/2	3 1/4	2-3/4	3-1/4	4	3-1/4	3-3/4	4-3/4	4	5-3/4
		(mm)	(38)	(38)	(51)	(64)	(51)	(64)	(83)	(70)	(83)	(102)	(83)	(95)	(121)	(102)	(146)
Min. member thickness	h_{min}	in.	3-1/4	3-1/4	4	5	4	5	5-1/2	5	5-1/2	6	5-1/2	6	8	8	10
		(mm)	(83)	(83)	(102)	(127)	(102)	(127)	(140)	(127)	(140)	(152)	(140)	(152)	(203)	(203)	(254)
Case 1	$c_{min,1}$	in.	1-1/2	5	2-1/2	2-1/2	2-3/4	2-1/2	2-1/4	4	3-1/4	2-1/4	5	4	3 3/4	3-3/4	3
		(mm)	(38)	(127)	(64)	(64)	(70)	(64)	(57)	(102)	(83)	(57)	(127)	(102)	(95)	(95)	(76)
	for $s_{min,1} \geq$	in.	1-1/2	8	5	5	5-1/2	4-1/2	5-1/4	7	5-1/2	7	11	7-1/2	5 3/4	10	6-3/4
		(mm)	(38)	(203)	(127)	(127)	(140)	(114)	(133)	(178)	(140)	(178)	(279)	(191)	(146)	(254)	(171)
Case 2	$c_{min,2}$	in.	1-1/2	8	4	3-1/2	4-1/8	4-1/2	4-1/2	5-1/2	4	4-1/4	8	6	5-1/4	4-1/4	3-3/4
		(mm)	(38)	(203)	(102)	(89)	(105)	(114)	(114)	(140)	(102)	(108)	(203)	(152)	(133)	(108)	(95)
	for $s_{min,2} \geq$	in.	1-1/2	5	2-1/4	2-1/4	2-3/4	2-1/2	2	5-1/2	2-3/4	3	5	4	4	5	4-3/4
		(mm)	(38)	(127)	(57)	(57)	(70)	(64)	(51)	(140)	(70)	(76)	(127)	(102)	(102)	(127)	(121)

1 Linear interpolation is permitted to establish an edge distance and spacing combination between Case 1 and Case 2. Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacings.

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Table 26 — Load adjustment factors for Stainless Steel 1/2-in. diameter KB-TZ2 in uncracked concrete [1,2]

1/2-in. KB-TZ2 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear [3] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ∥ To edge f_{RV}			Concrete thickness factor in shear [4] f_{HV}		
Effective Embedment h_{ef}	in. (mm)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)
Nominal Embedment h_{nom}	in. (mm)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h) - in. (mm) 2	(51)	n/a	n/a	0.60	n/a	n/a	n/a	n/a	n/a	0.54	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2-1/4	(57)	n/a	n/a	0.62	n/a	n/a	0.40	n/a	n/a	0.54	n/a	n/a	0.12	n/a	n/a	0.24	n/a	n/a	n/a
2-1/2	(64)	n/a	n/a	0.63	n/a	0.45	0.42	n/a	n/a	0.55	n/a	0.20	0.14	n/a	0.40	0.28	n/a	n/a	n/a
2-3/4	(70)	n/a	0.68	0.64	0.51	0.48	0.44	n/a	0.56	0.55	0.35	0.23	0.16	0.51	0.46	0.33	n/a	n/a	n/a
3	(76)	0.75	0.70	0.65	0.55	0.51	0.46	0.59	0.57	0.55	0.40	0.26	0.19	0.55	0.51	0.37	n/a	n/a	n/a
4	(102)	0.83	0.77	0.71	0.73	0.64	0.56	0.62	0.59	0.57	0.62	0.40	0.29	0.73	0.64	0.56	0.70	n/a	n/a
4-1/8	(105)	0.84	0.78	0.71	0.75	0.66	0.57	0.63	0.59	0.57	0.65	0.42	0.30	0.75	0.66	0.57	0.71	n/a	n/a
4-1/2	(114)	0.88	0.80	0.73	0.82	0.72	0.61	0.64	0.60	0.58	0.74	0.48	0.34	0.82	0.72	0.61	0.74	n/a	n/a
4-3/4	(121)	0.90	0.82	0.74	0.86	0.76	0.64	0.64	0.61	0.59	0.80	0.52	0.37	0.86	0.76	0.64	0.76	n/a	n/a
5	(127)	0.92	0.83	0.76	0.91	0.80	0.67	0.65	0.61	0.59	0.87	0.56	0.40	0.91	0.80	0.67	0.78	0.67	n/a
5-1/4	(133)	0.94	0.85	0.77	0.95	0.84	0.70	0.66	0.62	0.60	0.93	0.61	0.43	0.95	0.84	0.70	0.80	0.69	n/a
5-1/2	(140)	0.96	0.87	0.78	1.00	0.88	0.73	0.67	0.63	0.60	1.00	0.65	0.46	1.00	0.88	0.73	0.82	0.71	0.63
6	(152)	1.00	0.90	0.81		0.96	0.80	0.68	0.64	0.61		0.74	0.53		0.96	0.80	0.85	0.74	0.66
8	(203)		1.00	0.91		1.00	1.00	0.74	0.68	0.64		1.00	0.81		1.00	1.00	0.98	0.85	0.76
12	(305)			1.00				0.86	0.77	0.72			1.00				1.00	1.00	0.93
18	(457)							1.00	0.91	0.83									1.00
24	(610)								1.00	0.93									
> 30	(762)									1.00									

3.3.5

Table 27 — Load adjustment factors for Stainless Steel 1/2-in. diameter KB-TZ2 in cracked concrete [1,2]

1/2-in. KB-TZ2 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear [3] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ∥ To edge f_{RV}			Concrete thickness factor in shear [4] f_{HV}		
Effective Embedment h_{ef}	in. (mm)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)	2 (51)	2-1/2 (64)	3-1/4 (83)
Nominal Embedment h_{nom}	in. (mm)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)	2-1/2 (64)	3 (76)	3-3/4 (95)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h) - in. (mm) 2	(51)	n/a	n/a	0.60	n/a	n/a	n/a	n/a	n/a	0.54	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2-1/4	(57)	n/a	n/a	0.62	n/a	n/a	0.61	n/a	n/a	0.54	n/a	n/a	0.12	n/a	n/a	0.24	n/a	n/a	n/a
2-1/2	(64)	n/a	n/a	0.63	n/a	0.75	0.65	n/a	n/a	0.55	n/a	0.16	0.14	n/a	0.33	0.29	n/a	n/a	n/a
2-3/4	(70)	n/a	0.68	0.64	0.93	0.80	0.68	n/a	0.55	0.55	0.62	0.19	0.16	0.93	0.38	0.33	n/a	n/a	n/a
3	(76)	0.75	0.70	0.65	1.00	0.85	0.71	0.63	0.56	0.55	0.71	0.21	0.19	1.00	0.43	0.38	n/a	n/a	n/a
4	(102)	0.83	0.77	0.71	1.00	1.00	0.86	0.68	0.58	0.57	1.00	0.33	0.29	1.00	0.66	0.58	0.84	n/a	n/a
4-1/8	(105)	0.84	0.78	0.71	1.00	1.00	0.88	0.68	0.58	0.58	1.00	0.34	0.30	1.00	0.69	0.61	0.85	n/a	n/a
4-1/2	(114)	0.88	0.80	0.73		1.00	0.94	0.70	0.59	0.58		0.39	0.34		0.79	0.69	0.89	n/a	n/a
4-3/4	(121)	0.90	0.82	0.74			0.98	0.71	0.59	0.59		0.43	0.37		0.85	0.75	0.91	n/a	n/a
5	(127)	0.92	0.83	0.76			1.00	0.72	0.60	0.59		0.46	0.40		0.92	0.81	0.94	0.63	n/a
5-1/4	(133)	0.94	0.85	0.77				0.73	0.60	0.60		0.49	0.43		0.99	0.87	0.96	0.65	n/a
5-1/2	(140)	0.96	0.87	0.78				0.74	0.61	0.60		0.53	0.47		1.00	0.93	0.98	0.66	0.63
6	(152)	1.00	0.90	0.81				0.76	0.62	0.61		0.60	0.53			1.00	1.00	0.69	0.66
8	(203)		1.00	0.91				0.85	0.66	0.65		0.93	0.82					0.80	0.76
12	(305)			1.00				1.00	0.74	0.72		1.00	1.00					0.98	0.94
18	(457)								0.86	0.83								1.00	1.00
24	(610)								0.98	0.94									
> 30	(762)								1.00	1.00									

1 Linear interpolation not permitted
2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Engineering Design software or perform anchor calculation using design equations from ACI 318 Ch. 17 or CSA A23.3 Annex D.
3 Spacing factor reduction in shear, f_{AV}, is applicable when edge distance $c < 3h_{ef}$. If $c \geq 3h_{ef}$, then $f_{AV} = f_{AN}$.
4 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance $c < 3h_{ef}$. If $c \geq 3h_{ef}$ then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with Figure 3 and Table 21 to calculate permissible edge distance, spacing and concrete thickness combinations.

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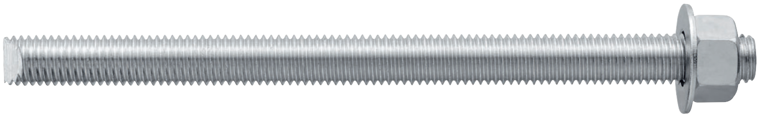
HIT-HY 200 V3 Adhesive with HAS Threaded Rod



Hilti HAS threaded rod

Figure 9 — Hilti HAS threaded rod installation conditions

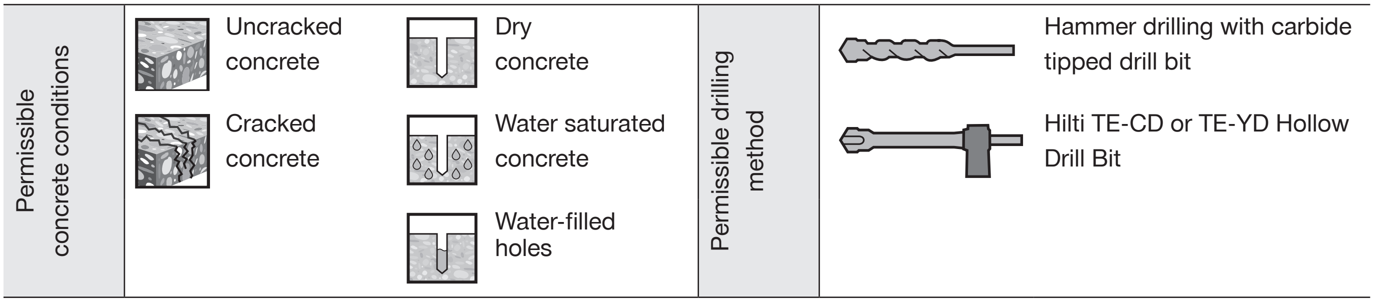
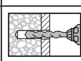
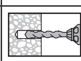


Table 38 — Hilti HAS threaded rod specifications

Setting information		Symbol	Units	Nominal rod diameter, d						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Nominal bit diameter		d_o	in.	7/16	9/16	3/4	7/8	1	1-1/8	1-3/8
Effective embedment	minimum	$h_{ef,min}$	in. (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
	maximum	$h_{ef,max}$	in. (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
Diameter of fixture hole	through-set		in.	1/2	5/8	13/16[1]	15/16[1]	1-1/8[1]	1-1/4[1]	1-1/2[1]
Diameter of fixture hole	preset		in.	7/16	9/16	11/16	13/16	15/16	1-1/8	1-3/8
Installation torque		T_{inst}	ft-lb (Nm)	15 (20)	30 (40)	60 (80)	100 (136)	125 (169)	150 (203)	200 (271)
Minimum concrete thickness		h_{min}	in. (mm)	h_{ef}+1-1/4 (h_{ef}+30)		$h_{ef}+2d_o$				
Minimum edge distance		c_{min}	in. (mm)	1-3/4 (45)	1-3/4 (45)	2[2] (50)[2]	2-1/8[2] (55)[2]	2-1/4[2] (60)[2]	2-3/4[2] (70)[2]	3-1/8[2] (80)[2]
Minimum anchor spacing		s_{min}	in. (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/4 (111)	5 (127)	6-1/4 (159)

1 Install using (2) washers. See Figure 11.
2 Edge distance of 1-3/4-inch (44mm) is permitted provided the installation torque is reduced to 0.30 T_{inst} for $5d < s < 16$-in. and to 0.5 T_{inst} for $s > 16$-in.

Figure 10 — Hilti HAS threaded rods

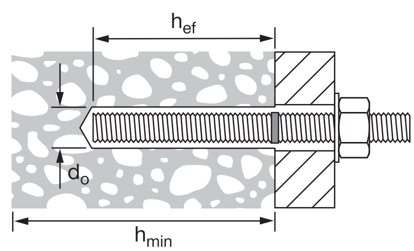


Figure 11 — Installation with (2) washers

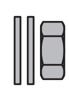


Table 40 — Hilti HIT-HY 200 V3 adhesive design strength with concrete / bond failure for threaded rod in cracked concrete [1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8	2-3/8 (60)	1,900 (8.5)	1,935 (8.6)	1,990 (8.9)	2,075 (9.2)	2,045 (9.1)	2,085 (9.3)	2,145 (9.5)	2,235 (9.9)
	3-3/8 (86)	2,700 (12.0)	2,750 (12.2)	2,830 (12.6)	2,950 (13.1)	5,815 (25.9)	5,925 (26.4)	6,095 (27.1)	6,350 (28.2)
	4-1/2 (114)	3,600 (16.0)	3,665 (16.3)	3,775 (16.8)	3,930 (17.5)	7,755 (34.5)	7,900 (35.1)	8,130 (36.2)	8,465 (37.7)
	7-1/2 (191)	6,000 (26.7)	6,110 (27.2)	6,290 (28.0)	6,550 (29.1)	12,925 (57.5)	13,165 (58.6)	13,550 (60.3)	14,110 (62.8)
1/2	2-3/4 (70)	2,520 (11.2)	2,760 (12.3)	3,185 (14.2)	3,480 (15.5)	5,425 (24.1)	5,945 (26.4)	6,865 (30.5)	7,490 (33.3)
	4-1/2 (114)	5,215 (23.2)	5,310 (23.6)	5,465 (24.3)	5,690 (25.3)	11,230 (50.0)	11,440 (50.9)	11,770 (52.4)	12,260 (54.5)
	6 (152)	6,955 (30.9)	7,080 (31.5)	7,290 (32.4)	7,590 (33.8)	14,975 (66.6)	15,250 (67.8)	15,695 (69.8)	16,345 (72.7)
	10 (254)	11,590 (51.6)	11,800 (52.5)	12,145 (54.0)	12,650 (56.3)	24,960 (111.0)	25,420 (113.1)	26,160 (116.4)	27,245 (121.2)
5/8	3-1/8 (79)	3,050 (13.6)	3,345 (14.9)	3,860 (17.2)	4,730 (21.0)	6,575 (29.2)	7,200 (32.0)	8,315 (37.0)	10,185 (45.3)
	5-5/8 (143)	7,370 (32.8)	8,075 (35.9)	8,805 (39.2)	9,170 (40.8)	15,875 (70.6)	17,390 (77.4)	18,960 (84.3)	19,745 (87.8)
	7-1/2 (191)	11,200 (49.8)	11,405 (50.7)	11,740 (52.2)	12,225 (54.4)	24,120 (107.3)	24,565 (109.3)	25,280 (112.5)	26,330 (117.1)
	12-1/2 (318)	18,665 (83.0)	19,010 (84.6)	19,565 (87.0)	20,375 (90.6)	40,205 (178.8)	40,940 (182.1)	42,135 (187.4)	43,880 (195.2)
3/4	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,605 (24.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	12,070 (53.7)
	6-3/4 (171)	9,690 (43.1)	10,615 (47.2)	12,255 (54.5)	14,215 (63.2)	20,870 (92.8)	22,860 (101.7)	26,395 (117.4)	30,620 (136.2)
	9 (229)	14,920 (66.4)	16,340 (72.7)	18,205 (81.0)	18,955 (84.3)	32,130 (142.9)	35,195 (156.6)	39,205 (174.4)	40,830 (181.6)
	15 (381)	28,945 (128.8)	29,480 (131.1)	30,340 (135.0)	31,595 (140.5)	62,345 (277.3)	63,490 (282.4)	65,345 (290.7)	68,050 (302.7)
7/8	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,605 (24.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	12,070 (53.7)
	7-7/8 (200)	12,210 (54.3)	13,375 (59.5)	15,445 (68.7)	18,915 (84.1)	26,300 (117.0)	28,810 (128.2)	33,265 (148.0)	40,740 (181.2)
	10-1/2 (267)	18,800 (83.6)	20,590 (91.6)	23,780 (105.8)	26,415 (117.5)	40,490 (180.1)	44,355 (197.3)	51,215 (227.8)	56,895 (253.1)
	17-1/2 (445)	40,335 (179.4)	41,080 (182.7)	42,280 (188.1)	44,025 (195.8)	86,880 (386.5)	88,475 (393.6)	91,060 (405.1)	94,830 (421.8)
1	4 (102)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
	9 (229)	14,920 (66.4)	16,340 (72.7)	18,870 (83.9)	23,110 (102.8)	32,130 (142.9)	35,195 (156.6)	40,640 (180.8)	49,775 (221.4)
	12 (305)	22,965 (102.2)	25,160 (111.9)	29,050 (129.2)	35,440 (157.6)	49,465 (220.0)	54,190 (241.0)	62,570 (278.3)	76,330 (339.5)
	20 (508)	49,415 (219.8)	54,135 (240.8)	56,720 (252.3)	59,065 (262.7)	106,435 (473.4)	116,595 (518.6)	122,160 (543.4)	127,215 (565.9)
1-1/4	5 (127)	6,175 (27.5)	6,765 (30.1)	7,815 (34.8)	9,570 (42.6)	13,305 (59.2)	14,575 (64.8)	16,830 (74.9)	20,610 (91.7)
	11-1/4 (286)	20,850 (92.7)	22,840 (101.6)	26,370 (117.3)	32,295 (143.7)	44,905 (199.7)	49,190 (218.8)	56,800 (252.7)	69,565 (309.4)
	15 (381)	32,095 (142.8)	35,160 (156.4)	40,600 (180.6)	49,725 (221.2)	69,135 (307.5)	75,730 (336.9)	87,445 (389.0)	107,100 (476.4)
	25 (635)	69,060 (307.2)	75,655 (336.5)	87,360 (388.6)	96,120 (427.6)	148,750 (661.7)	162,945 (724.8)	188,155 (837.0)	207,030 (920.9)

1 See section 3.1.8 for explanation on development of load values.
2 See section 3.1.8 to convert design strength (factored resistance) value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 42 - 55 as necessary to the above values. Compare to the steel values in table 41. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130° F (55° C), max. long term temperature = 110° F (43° C).
For temperature range B: Max. short term temperature = 176° F (80° C), max. long term temperature = 110° F (43° C).
For temperature range C: Max. short term temperature = 248° F (120° C), max. long term temperature = 162° F (72° C) multiply above values by 0.82.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry and water saturated concrete conditions. For water-filled concrete multiply design strength value by 0.42.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete, multiply design strength (factored resistance) by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values in tension and shear by the following reduction factors:
3/8-in diameter - α_{seis} = 0.66
1/2-in, 5/8-in, and 1-1/4-in diameter - α_{seis} = 0.74
3/4-in and 7/8-in diameter - α_{seis} = 0.75
1-in diameter - α_{seis} = 0.71
See section 3.1.8 for additional information on seismic applications.

Table 41 — Steel design strength for Hilti HAS threaded rods for use with ACI 318 Chapter 17

Nominal anchor diameter in.	HAS-V-36 / HAS-V-36 HDG ASTM F1554 Gr. 36[4,6]			HAS-E-55 / HAS-E-55 HDG ASTM F1554 Gr. 55[4,6]			HAS-B-105 and HAS-B-105 HDG ASTM A193 B7 and ASTM F 1554 Gr.105[4,6]			HAS-R stainless steel ASTM F593 (3/8-in to 1-in)[5] ASTM A193 (1-1/8-in to 2-in)[4]		
	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)
3/8	3,370 (15.0)	1,750 (7.8)	1,050 (4.7)	4,360 (19.4)	2,270 (10.1)	1,590 (7.1)	7,270 (32.3)	3,780 (16.8)	2,645 (11.8)	5,040 (22.4)	2,790 (12.4)	1,955 (8.7)
1/2	6,175 (27.5)	3,210 (14.3)	1,925 (8.6)	7,985 (35.5)	4,150 (18.5)	2,905 (12.9)	13,305 (59.2)	6,920 (30.8)	4,845 (21.6)	9,225 (41.0)	5,110 (22.7)	3,575 (15.9)
5/8	9,835 (43.7)	5,110 (22.7)	3,065 (13.6)	12,715 (56.6)	6,610 (29.4)	4,625 (20.6)	21,190 (94.3)	11,020 (49.0)	7,715 (34.3)	14,690 (65.3)	8,135 (36.2)	5,695 (25.3)
3/4	14,550 (64.7)	7,565 (33.7)	4,540 (20.2)	18,820 (83.7)	9,785 (43.5)	6,850 (30.5)	31,360 (139.5)	16,310 (72.6)	11,415 (50.8)	18,485 (82.2)	10,235 (45.5)	7,165 (31.9)
7/8	20,085 (89.3)	10,445 (46.5)	6,265 (27.9)	25,975 (115.5)	13,505 (60.1)	9,455 (42.1)	43,285 (192.5)	22,510 (100.1)	15,755 (70.1)	25,510 (113.5)	14,125 (62.8)	9,890 (44.0)
1	26,350 (117.2)	13,700 (60.9)	8,220 (36.6)	34,075 (151.6)	17,720 (78.8)	12,405 (55.2)	56,785 (252.6)	29,530 (131.4)	20,670 (91.9)	33,465 (148.9)	18,535 (82.4)	12,975 (57.7)
1-1/4	42,160 (187.5)	21,920 (97.5)	13,150 (58.5)	54,515 (242.5)	28,345 (126.1)	19,840 (88.3)	90,855 (404.1)	47,245 (210.2)	33,070 (147.1)	41,430 (184.3)	21,545 (95.8)	12,925 (57.5)

1 Tensile = $\phi A_{se,N} f_{uta}$ as noted in ACI 318 17.4.1.2
2 Shear = $\phi\ 0.60 A_{se,V} f_{uta}$ as noted in ACI 318 17.5.1.2b.
3 Seismic Shear = $\alpha_{V,seis}\ \phi V_{sa}$: Reduction factor for seismic shear only. See ACI 318 for additional information on seismic applications.
4 HAS-V, HAS-E (3/8-in to 1-1/4-in), HAS-B, and HAS-R (Class 1; 1-1/4-in) threaded rods are considered ductile steel elements (including HDG rods).
5 HAS-R (CW1 and CW2; 3/8-in to 1-in) threaded rods are considered brittle steel elements.
6 3/8-inch dia. threaded rods are not included in the ASTM F1554 standard. Hilti 3/8-inch dia. HAS-V, HAS-E, and HAS-E-B (incl. HDG) threaded rods meet the chemical composition and mechanical property requirements of ASTM F1554.

Table 44 — Load adjustment factors for 1/2-in. diameter threaded rods in uncracked concrete[1,2,3]

1/2-in. threaded rods uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / Edge distance (c_a) / Concrete thickness (h), - in. (mm): 1-3/4 (44)	n/a	n/a	n/a	n/a	0.34	0.25	0.19	0.11	n/a	n/a	n/a	n/a	0.10	0.05	0.03	0.02	0.21	0.11	0.07	0.03	n/a	n/a	n/a	n/a
2-1/2 (64)	0.58	0.58	0.57	0.54	0.41	0.28	0.22	0.13	0.55	0.53	0.53	0.52	0.18	0.09	0.06	0.03	0.35	0.18	0.12	0.06	n/a	n/a	n/a	n/a
3 (76)	0.60	0.60	0.58	0.55	0.46	0.30	0.24	0.14	0.56	0.54	0.53	0.52	0.23	0.12	0.08	0.04	0.46	0.24	0.15	0.08	n/a	n/a	n/a	n/a
4 (102)	0.63	0.63	0.61	0.57	0.57	0.35	0.27	0.16	0.58	0.55	0.54	0.53	0.36	0.18	0.12	0.06	0.57	0.35	0.24	0.12	0.58	n/a	n/a	n/a
5 (127)	0.67	0.67	0.64	0.58	0.71	0.41	0.31	0.18	0.60	0.57	0.55	0.53	0.50	0.26	0.17	0.08	0.71	0.41	0.31	0.17	0.65	n/a	n/a	n/a
5-3/4 (146)	0.69	0.69	0.66	0.60	0.81	0.45	0.34	0.20	0.62	0.58	0.56	0.54	0.61	0.32	0.21	0.10	0.81	0.45	0.34	0.20	0.69	0.56	n/a	n/a
6 (152)	0.70	0.70	0.67	0.60	0.85	0.46	0.35	0.20	0.63	0.58	0.56	0.54	0.65	0.34	0.22	0.11	0.85	0.46	0.35	0.20	0.71	0.57	n/a	n/a
7 (178)	0.74	0.74	0.69	0.62	0.96	0.53	0.39	0.23	0.65	0.59	0.57	0.54	0.82	0.42	0.28	0.14	0.96	0.53	0.39	0.23	0.77	0.61	n/a	n/a
7-1/4 (184)	0.74	0.74	0.70	0.62	0.98	0.54	0.40	0.23	0.65	0.60	0.57	0.55	0.87	0.45	0.29	0.15	0.98	0.54	0.40	0.23	0.78	0.62	0.54	n/a
8 (203)	0.77	0.77	0.72	0.63	1.00	0.60	0.44	0.26	0.67	0.61	0.58	0.55	1.00	0.52	0.34	0.17	1.00	0.60	0.44	0.26	0.82	0.66	0.57	n/a
9 (229)	0.80	0.80	0.75	0.65		0.68	0.50	0.29	0.69	0.62	0.59	0.56		0.62	0.40	0.20		0.68	0.50	0.29	0.87	0.70	0.60	n/a
10 (254)	0.84	0.84	0.78	0.67		0.75	0.55	0.32	0.71	0.63	0.60	0.56		0.72	0.47	0.24		0.75	0.55	0.32	0.92	0.73	0.64	n/a
11-1/4 (286)	0.88	0.88	0.81	0.69		0.84	0.62	0.36	0.74	0.65	0.61	0.57		0.86	0.56	0.28		0.84	0.62	0.36	0.97	0.78	0.67	0.54
12 (305)	0.90	0.90	0.83	0.70		0.90	0.66	0.39	0.75	0.66	0.62	0.58		0.95	0.62	0.31		0.90	0.66	0.39	1.00	0.80	0.70	0.55
14 (356)	0.97	0.97	0.89	0.73		1.00	0.77	0.45	0.79	0.69	0.64	0.59		1.00	0.78	0.39		1.00	0.77	0.45		0.87	0.75	0.60
16 (406)	1.00	1.00	0.94	0.77			0.88	0.52	0.83	0.72	0.66	0.60			0.95	0.48			0.88	0.52		0.93	0.80	0.64
18 (457)			1.00	0.80			0.99	0.58	0.88	0.74	0.68	0.62			1.00	0.58			0.99	0.58		0.98	0.85	0.68
20 (508)				0.83			1.00	0.64	0.92	0.77	0.70	0.63				0.67			1.00	0.64		1.00	0.90	0.72
22 (559)				0.87				0.71	0.96	0.80	0.72	0.64				0.78				0.71			0.94	0.75
24 (610)				0.90				0.77	1.00	0.82	0.74	0.65				0.89				0.77			0.98	0.78
30 (762)				1.00				0.97		0.90	0.80	0.69				1.00				0.97			1.00	0.88
36 (914)								1.00		0.98	0.86	0.73								1.00				0.96
>48 (1219)										1.00	0.98	0.81												1.00

Table 45 — Load adjustment factors for 1/2-in. diameter threaded rods in cracked concrete[1,2,3]

1/2-in. threaded rods cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / Edge distance (c_a) / Concrete thickness (h), - in. (mm): 1-3/4 (44)	n/a	n/a	n/a	n/a	0.48	0.48	0.45	0.41	n/a	n/a	n/a	n/a	0.10	0.05	0.04	0.02	0.21	0.11	0.08	0.05	n/a	n/a	n/a	n/a
2-1/2 (64)	0.58	0.58	0.57	0.54	0.54	0.54	0.50	0.44	0.55	0.53	0.53	0.52	0.18	0.09	0.07	0.04	0.35	0.19	0.14	0.08	n/a	n/a	n/a	n/a
3 (76)	0.60	0.60	0.58	0.55	0.58	0.58	0.53	0.46	0.56	0.54	0.53	0.52	0.23	0.12	0.09	0.06	0.47	0.25	0.18	0.11	n/a	n/a	n/a	n/a
4 (102)	0.63	0.63	0.61	0.57	0.66	0.66	0.60	0.49	0.58	0.55	0.55	0.53	0.36	0.19	0.14	0.09	0.66	0.38	0.28	0.17	0.58	n/a	n/a	n/a
5 (127)	0.67	0.67	0.64	0.58	0.76	0.76	0.67	0.53	0.61	0.57	0.56	0.54	0.50	0.26	0.20	0.12	0.76	0.53	0.40	0.24	0.65	n/a	n/a	n/a
5-3/4 (146)	0.69	0.69	0.66	0.60	0.83	0.83	0.73	0.56	0.62	0.58	0.57	0.55	0.62	0.33	0.24	0.15	0.83	0.65	0.49	0.29	0.70	0.56	n/a	n/a
6 (152)	0.70	0.70	0.67	0.60	0.85	0.85	0.75	0.57	0.63	0.58	0.57	0.55	0.66	0.35	0.26	0.16	0.85	0.70	0.52	0.31	0.71	0.57	n/a	n/a
7 (178)	0.74	0.74	0.69	0.62	0.96	0.96	0.83	0.62	0.65	0.60	0.58	0.56	0.83	0.44	0.33	0.20	0.96	0.88	0.66	0.39	0.77	0.62	n/a	n/a
7-1/4 (184)	0.74	0.74	0.70	0.62	0.98	0.98	0.85	0.63	0.65	0.60	0.58	0.56	0.88	0.46	0.35	0.21	0.98	0.92	0.69	0.42	0.78	0.63	0.57	n/a
8 (203)	0.77	0.77	0.72	0.63	1.00	1.00	0.91	0.66	0.67	0.61	0.59	0.56	1.00	0.54	0.40	0.24	1.00	1.00	0.80	0.48	0.82	0.66	0.60	n/a
9 (229)	0.80	0.80	0.75	0.65			1.00	0.70	0.69	0.62	0.60	0.57		0.64	0.48	0.29			0.96	0.58	0.87	0.70	0.64	n/a
10 (254)	0.84	0.84	0.78	0.67				0.75	0.71	0.64	0.61	0.58		0.75	0.56	0.34			1.00	0.67	0.92	0.74	0.67	n/a
11-1/4 (286)	0.88	0.88	0.81	0.69				0.81	0.74	0.65	0.63	0.59		0.89	0.67	0.40				0.80	0.97	0.79	0.71	0.60
12 (305)	0.90	0.90	0.83	0.70				0.85	0.75	0.66	0.64	0.60		0.98	0.74	0.44				0.85	1.00	0.81	0.74	0.62
14 (356)	0.97	0.97	0.89	0.73				0.95	0.79	0.69	0.66	0.61		1.00	0.93	0.56				0.95		0.88	0.80	0.67
16 (406)	1.00	1.00	0.94	0.77				1.00	0.84	0.72	0.68	0.63			1.00	0.68				1.00		0.94	0.85	0.72
18 (457)			1.00	0.80					0.88	0.75	0.70	0.65				0.81						0.99	0.90	0.76
20 (508)				0.83					0.92	0.77	0.73	0.66				0.95						1.00	0.95	0.80
22 (559)				0.87					0.96	0.80	0.75	0.68				1.00							1.00	0.84
24 (610)				0.90					1.00	0.83	0.77	0.69												0.88
30 (762)				1.00						0.91	0.84	0.74												0.98
36 (914)										0.99	0.91	0.79												1.00
>48 (1219)										1.00	1.00	0.89												

1 Linear interpolation not permitted
2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when c < 3*h_{ef}. f_{AV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{AV} = f_{AN}.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{HV} = 1.0.