THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Corrections
DIVISION OF ADMINISTRATIVE SERVICES

802 3rd Street, Suite 224
Douglas, Alaska 99824
Main: 907.465.6014
Email: Michael.lim@alaska.gov

Issue Date: October 9, 2023

ATTN: Vendors

RE:	**Project Name:**	SCCC Transformer and Pad Replacement Project
	Project Number:	230004026-1
	Project Location:	Seward, Alaska
	New RFP Deadline:	**October 20, 2023 @ 2:00 p.m. local time**

Addendum # One (1)

This addendum forms a part of the contract documents and modifies the original drawings and/or specifications for the subject work. In case of conflicts between this addendum and previously issued documents, this addendum shall take precedence.

The following additions are required:

1. Attached are the IFB Calculations and IFB Specifications drawings.

The following are questions from interested parties and the department's response:

1. This reference modifying setting for the transformer VFI. Does the new 2000kVA transformer require a Vacuum Fault Interrupter? If so, please provide the specifications for a VFI Transformer.

   RESPONSE: Please refer to the above drawings.

This addendum is considered part of the Request for Proposal (RFP) and is to be acknowledge on your bid proposal.

Please contact me if you have any questions.

Sincerely,

Michael Lim

Michael Lim
Procurement Specialist V

cc: John Gard, Facilities Manager I, DOC
Clif Reagle Facilities Manager II, DOC

End of Addendum

Spring Creek Correctional Center Transformer Replacement Project

– CALCULATIONS –

ISSUED FOR BIDDING

April 27, 2023

Agreement# 230004026

Prepared for:

STATE OF ALASKA, DEPARTMENT OF CORRECTIONS

Prepared by:

COFFMAN ENGINEERS

STRUCTURAL CALCULATIONS for

SCCC TRANSFORMER AND PAD REPLACEMENT

SEWARD, AK

ALASKA DEPARTMENT OF CORRECTIONS

Date: MAR 23

CEI Project No 222187

FINAL DESIGN

COFFMAN ENGINEERS, INC. 800 F STREET ANCHORAGE AK 99501
ph 907.276.6664 fax 907.276.5042 AECC 249

COFFMAN ENGINEERS

project	**SCCC TRANSFORMER AND PAD REPLAC**	by	**JAC**	sheet no.
location	**SEWARD, AK**	date	**MAR 23**	
client	**ALASKA DEPARTMENT OF CORRECTION**	checked	**MCS**	job no.
topic	**STRUCTURAL CALCULATIONS**	date	**MAR 23**	**222793**

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

Search Information

Coordinates: 60.09403453389056, -149.3390210431396

Elevation: 76 ft

Timestamp: 2023-01-09T20:10:35.682Z

Hazard Type: Snow

ASCE 7-16		ASCE 7-10		ASCE 7-05	
Ground Snow Load	50 lb/sqft	Ground Snow Load	50 lb/sqft	Ground Snow Load	50 lb/sqft

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer.

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Hazards by Location

Search Information

Coordinates: 60.09403453389056, -149.3390210431396

Elevation: 76 ft

Timestamp: 2023-01-09T20:09:01.729Z

Hazard Type: Wind

ASCE 7-16

MRI 10-Year	111 mph
MRI 25-Year	121 mph
MRI 50-Year	131 mph
MRI 100-Year	136 mph
Risk Category I	151 mph
Risk Category II	161 mph
Risk Category III	171 mph
Risk Category IV	176 mph

ASCE 7-10

MRI 10-Year	113 mph
MRI 25-Year	122 mph
MRI 50-Year	131 mph
MRI 100-Year	139 mph
Risk Category I	151 mph
Risk Category II	161 mph
Risk Category III-IV	166 mph

ASCE 7-05

ASCE 7-05 Wind Speed	131 mph

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Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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WIND LOAD CRITERIA - MWFRS VELOCITY PRESSURES

WIND LOAD CALCULATIONS ARE IN ACCORDANCE WITH THE 2021 INTERNATIONAL BUILDING CODE (IBC) AND ASCE 7-16 AS ADOPTED BY THE CITY OF SEWARD. VELOCITY PRESSURE PER CHAPTER 26: WIND LOAD GENERAL REQUIREMENTS.

VELOCITY PRESSURES

RISK CATEGORY		IV	IBC TABLE 1604.5
BASIC WIND SPEED	V =	176 MPH	ASCE 7-16 FIGURE 26.5-1
DIRECTIONALITY FACTOR	Kd =	0.85	ASCE 7-16 TABLE 26.6-1
TOPOGRAPHIC FACTOR	Kzt =	1.00	ASCE 7-16 FIGURE 26.8-1
GROUND ELEVATION FACTOR	Ke =	1.00	ASCE 7-16 TABLE 26.9-1
EXPOSURE CATEGORY		C	ASCE 7-16 SECTION 26.7.3

REFERENCE

HEIGHT, Z (FT)	PRESSURE COEFFICIENT, Kz	VELOCITY PRESSURE, Qz (PSF)
0	0.85	57.22
15	0.85	57.22
20	0.90	60.79
25	0.95	63.71
30	0.98	66.21
40	1.04	70.34
50	1.09	73.72
60	1.14	76.61
*6	0.85	57.22
**6	0.85	57.22

*MEAN ROOF HEIGHT, h (FT)

**EVE HEIGHT, he (FT)

ASCE 7-16 REFERENCE

EQUATION. 26.10-1 Qz = 0.00256*Kz*Kzt*Kd*Ke*V^2

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The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

Search Information

Coordinates:	60.09403453389056, -149.3390210431396
Elevation:	76 ft
Timestamp:	2023-01-09T20:12:37.738Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	IV
Site Class:	D-default

Basic Parameters

Name	Value	Description
S_S	1.5	MCE_R ground motion (period=0.2s)
S_1	0.722	MCE_R ground motion (period=1.0s)
S_{MS}	1.8	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.2	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	1.093	Coefficient of risk (0.2s)
CR_1	1.019	Coefficient of risk (1.0s)
PGA	0.5	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.6	Site modified peak ground acceleration
T_L	16	Long-period transition period (s)
SsRT	1.899	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.738	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.903	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.887	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.722	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

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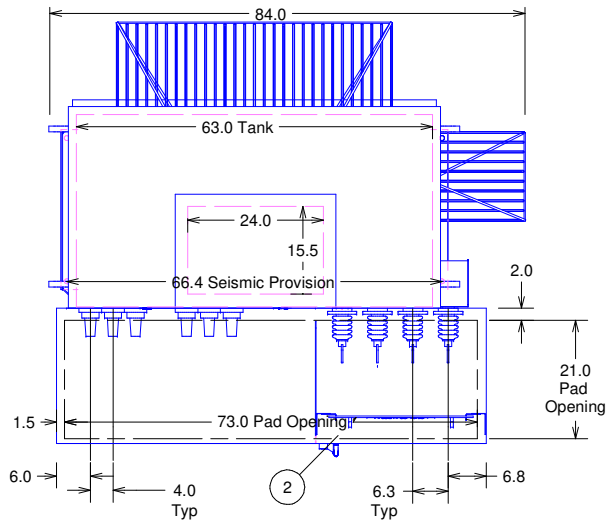
Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

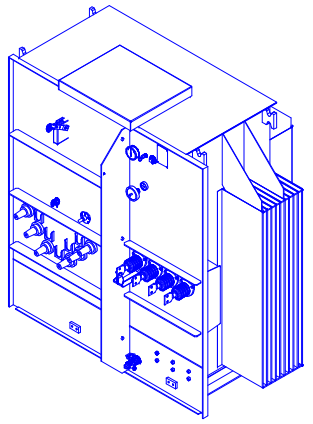
Disclaimer

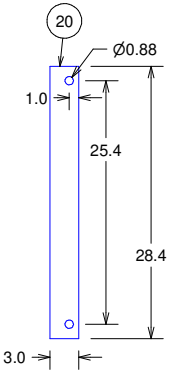
Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

ITEM	DESCRIPTION
1	Arrester Mounting Provision
2	Barrier LV Liftoff
3	Welded Cover w/ Handhole
4	Cooling Corrugate
5	Drain Valve with Sampler
6	Ground Pad .50-13 Tap
7	Ground Strap and Pad
8	High Security Cabinet w/ 1 Pentahead Door Bolt per door
9	15kV 600 Amp Deadbreak HV Bushing
10	Lifting Lug
11	Liquid Temperature Gauge
12	15 kV LV Bushing w/ 2 Hole Spade
13	Magnetic Oil Level Gauge
14	Nameplate
15	One Inch Upper Press. Conn. and Fill Plug
16	Two Position Loadbreak Switch
17	Parking Stand
18	Pressure Relief Valve
19	Pressure Vacuum Gauge
20	Seismic Anchor Provisions
21	Tank Base w/ Jacking and Rolling Facilities
22	5-Position Tap Changer
23	Vacuum Fault Interrupter
24	H0/X0 Bushing

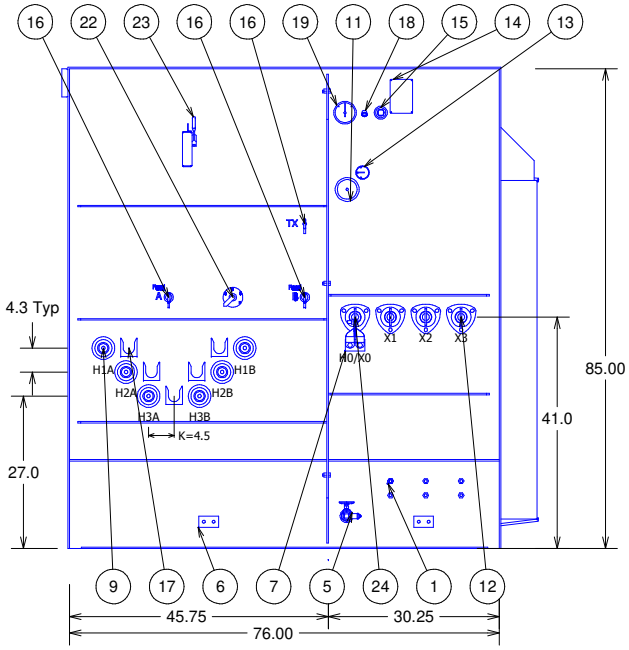


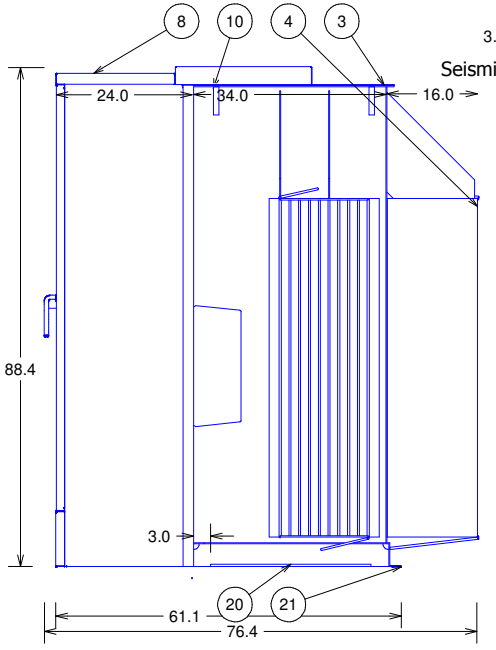
Cabinet Removed





Seismic Provision Detail





3PH Padmount Transformer 60Hz
1500.0 kVA ONAN 65 AWR Mineral Oil
HV 12470GY/7200 95 kV BIL
LV 4160Y/2400 60 kV BIL
5.74 %IZ
Approximate Weight 11739 lbs.
Munsell Green Topcoat
Mild Steel Construction
UL Listed
DESIGN #: 1

MATERIAL:

ALL DIMENSIONS ARE IN INCHES [MM]

THIS DRAWING HAS BEEN GENERATED FROM A 3D MODEL.

EATON
Powering Business Worldwide

TITLE: Distribution Transformer Outline Drawing

DESC: **COOPER POWER SERIES** THREE-PHASE PAD-MOUNTED COMPARTMENTAL TYPE

DWG:	DATE:	REF:	SHEET #:	SCALE:	REV:
PTP	1/9/2023	P3D V04R03M08	1 OF 1		00

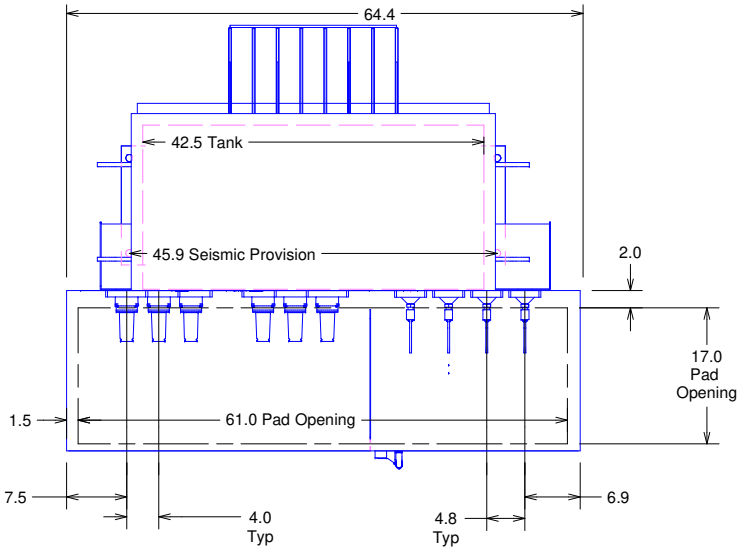
H100P75Z

H100P75Z
REVISIONS

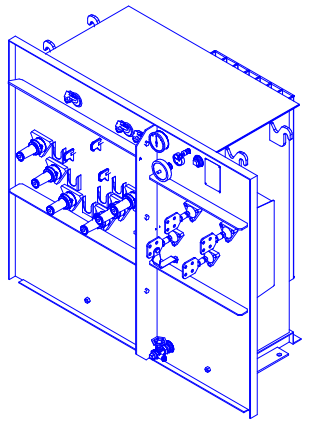
ITEM	DESCRIPTION
1	Bolted Cover w/ Nutguard
2	Cooling Corrugate
3	Cooper Bayonet Fusing w/ Dripshield
4	Current Limiting Backup Fuses (Internal)
5	Drain Valve with Sampler
6	Ground Nut .50-13 Tap
7	Ground Strap and Nut
8	High Security Cabinet w/ 1 Pentahead Door Bolt per door
9	35kV 200 Amp HV Bushing Well w/ 15kV Insert
10	Lifting Lug
11	Liquid Temperature Gauge
12	1.2kV LV Bushing w/ 4 Hole Spade
13	Magnetic Oil Level Gauge
14	Nameplate
15	One Inch Upper Press. Conn. and Fill Plug
16	Two Position Loadbreak Switch
17	Parking Stand
18	Pressure Relief Valve
19	Pressure Vacuum Gauge
20	Seismic Anchor Provisions
21	Tank Base w/ Jacking and Rolling Facilities
22	5-Position Tap Changer
23	H0/X0 Bushing

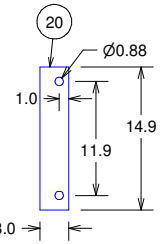
H100VYLQ

REVISIONS

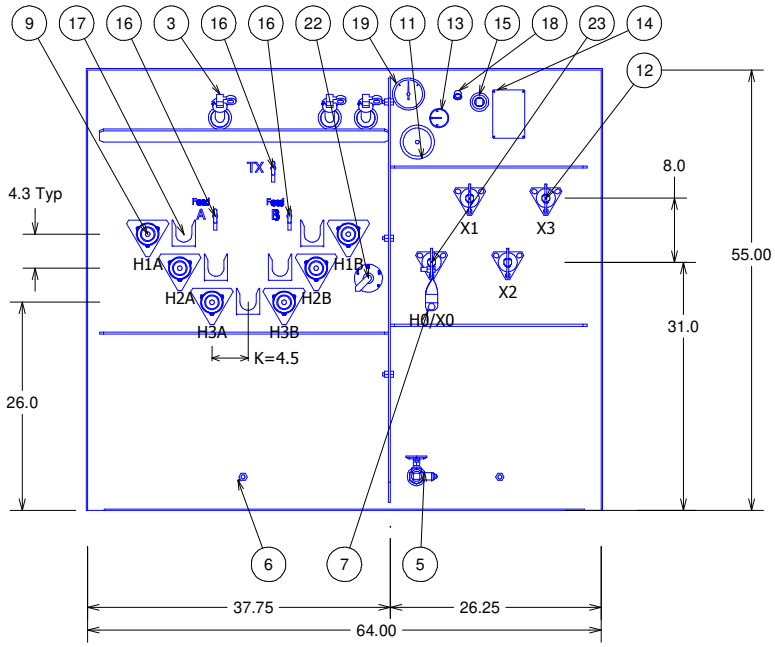


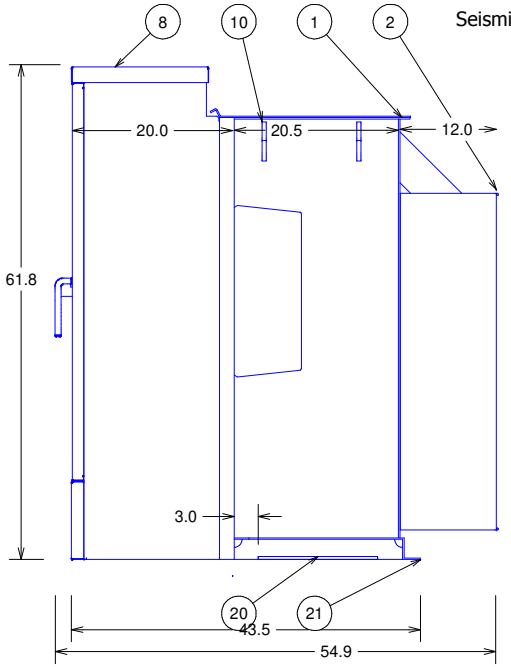
Cabinet Removed





Seismic Provision Detail





3PH Padmount Transformer 60Hz
300.0 kVA ONAN 65 AWR Mineral Oil
HV 12470GY/7200 95 kV BIL
LV 480Y/277 30 kV BIL
4.76 %IZ
Approximate Weight 3619 lbs.
Munsell Green Topcoat
Mild Steel Construction
UL Listed
DESIGN #: 1

MATERIAL:

ALL DIMENSIONS ARE IN INCHES [MM]

THIS DRAWING HAS BEEN GENERATED FROM A 3D MODEL.

EATON
Powering Business Worldwide

TITLE: Distribution Transformer Outline Drawing

DESC: **COOPER POWER SERIES** THREE-PHASE PAD-MOUNTED COMPARTMENTAL TYPE

DWG:	DATE:	REF:	SHEET #:	SCALE:	REV:
PTP	1/11/2023	P3D V04R03M08	1 OF 1		00

H100VYLQ

SEISMIC DESIGN CRITERIA

SEISMIC DESIGN IS IN ACCORDANCE WITH THE 2021 INTERNATIONAL BUILDING CODE (IBC) AND ASCE 7-16 AS ADOPTED BY THE CITY OF SEWARD. ANALYSIS PROCEDURE IS CHAPTER 13 - NONSTRUCTURAL COMPONENTS.

SPECTRAL RESPONSE VALUES				**ASCE 7-16 REFERENCE**	
RISK CATEGORY		IV		TABLE 1.5-1	
IMPORTANCE FACTOR	Ip =	1.50		SECTION 13.1.3	
0.2 SEC SPECTRAL RESPONSE	Ss =	150%	g	FIGURE 22-1	
SITE CLASS		D - default		TABLE 20.3-1	
SHORT-PERIOD SITE COEFFICIENT	Fa =	1.20		SECTION 11.4.4 OR TABLE 11.4-1	
ADJUSTED SPECTRAL RESPONSE	Sms =	1.80	g	EQUATION 11.4-1	Sms = Fa*Ss
DESIGN SPECTRAL RESPONSE	Sds =	1.20	g	EQUATION 11.4-3	Sds = (2/3)*Sms
SEISMIC DESIGN CATEGORY	SDC =	D		TABLES 11.6-1 & 11.6-2	

SEISMIC DEMAND ON COMPONENT				**ASCE 7-16 REFERENCE**	
COMPONENT DESCRIPTION		1500KVA TRANSFORMER		TABLE 13.5-1 OR 13.6-1	
AMPLIFICATION FACTOR	Ap =	1.00		TABLE 13.5-1 OR 13.6-1	
RESPONSE MODIFICATION FACTOR	Rp =	2.50		TABLE 13.5-1 OR 13.6-1	
OVERSTRENGTH FACTOR	Ωo=	2.00		TABLE 13.5-1 OR 13.6-1	
COMPONENT HEIGHT	z =	0.0	FT	SECTION 13.3.1.1	
STRUCTURE HEIGHT	h =	1.0	FT	SECTION 13.3.1.1	
COMPONENT WEIGHT	Wp =	10775	LBS		
	z/h =	0.00		SECTION 13.3.1.1	0 ≤ z/h ≤ 1.0
HORIZONTAL SEISMIC FORCE	Fp =	3103	LBS	EQUATION 13.3-1	Fp = [(0.4*Ap*Sds*Wp)/(Rp/Ip)]*[1+2*(z/h)]
UPPER LIMIT	Fp max =	31032	LBS	EQUATION 13.3-2	Fp ≤ 1.6*Sds*Ip*Ip
LOWER LIMIT	Fp min =	5819	LBS	EQUATION 13.3-3	Fp ≥ 0.3*Sds*Ip*Wp

HORIZONTAL SEISMIC FORCE	**USE Fp =**	**5819**	**LBS**		
CONCURRENT VERTICAL FORCE		**2586**	**LBS**	SECTION 13.3.1.2	0.2*Sds*Wp

COFFMAN ENGINEERS

project	**SCCC TRANSFORMER AND PAD REPLAC**	by	**JAC**	sheet no.
location	**SEWARD, AK**	date	**FEB 2023**	
client	**ALASKA DEPARTMENT OF CORRECTION**	checked	**0**	job no.
topic	**SEISMIC LOAD ON COMPONENT**	date	**FEB 2023**	**222793**

1500 kVA TXFR SLAB AND ANCHOR DESIGN CRITERIA

- Eaton 1500 kVA, pad-mounted transformer

D = 11750 lb

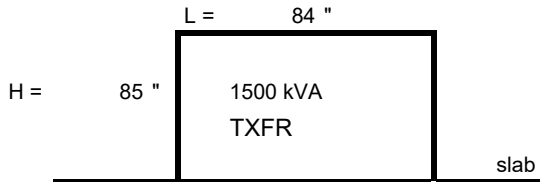
Seismic Load See seismic demand on non-structural component calculation sheet

F_p = 5819 lb

E_v = ± 2586 lb

Wind Load

q_z =	57.2	psf	See wind velocity pressure calculation sheet	ASCE 26
A_g =	49.6	ft^2	Project area of non-structural component	ASCE 29.4

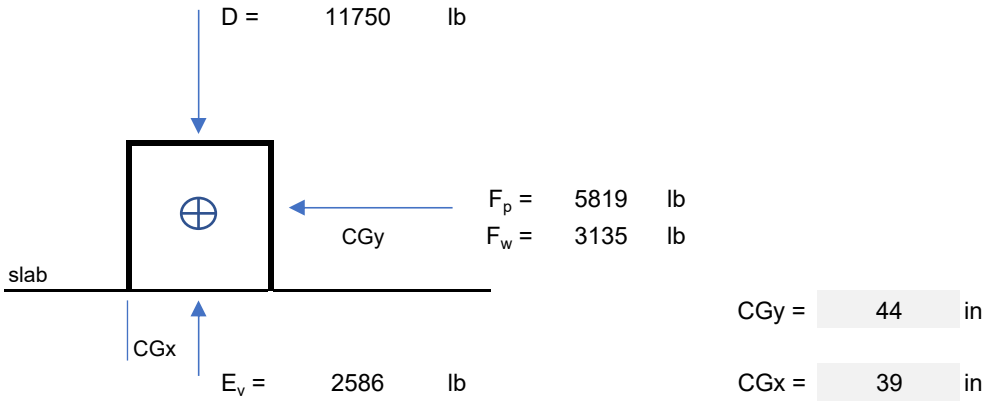


G =	0.85		Gust effect factor	ASCE 26.11
C_f =	1.3		Force Coefficient	ASCE Fig. 29-4.1
$F_w = q_z A_g G C_f$ =	3135	lb	Design wind force	ASCE Equ. 29.4-1

COFFMAN ENGINEERS	project	**SCCC TRANSFORMER AND PAD REPLAC**	by **JAC**	sheet no.
	location	**SEWARD, AK**	date **FEB 2023**	1
	client	**ALASKA DEPARTMENT OF CORRECTION**	checked	job no.
	topic		date **FEB 2023**	**222793**

1500 kVA TXFR SLAB AND ANCHOR DESIGN CRITERIA CONTINUED

Slab loads for RISA Foundation model



Soil properties for RISA Foundation model

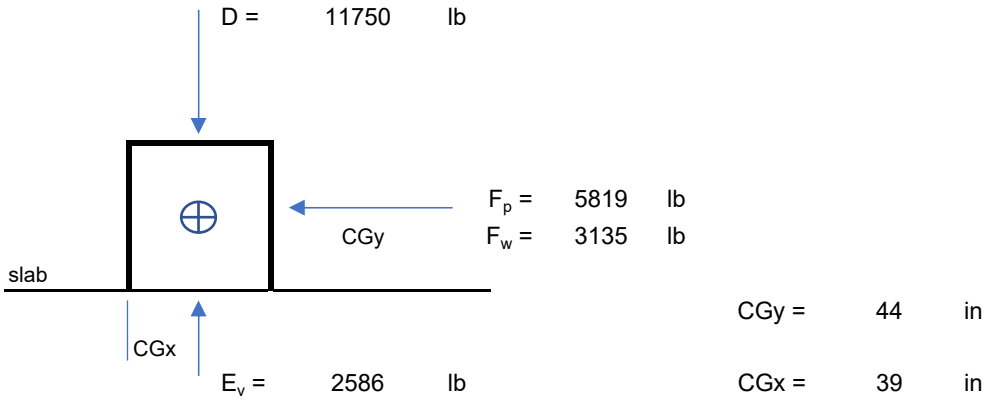
"Subsurface Exploration and Geotechnical Engineering Report" prepared for Spring Creek Correctional Center by R.Z.A. Inc. Geotechnical Consultants, dated July 1984 provided to design team. Specific geotechnical investigation not included in this project. Refer IBC presumptive soil values, Table 1806.2

Bearing Capacity:	2000 psf plus 1/3 for Wind and Seismic loading	
Lateral Bearing Capacity:	150 psf	(assumed)
Coefficient of Friction:	ϕ = 0.25	(assumed)

Provide 12-inch thick foundation slab that is approximately 12" larger in each direction than the equipment to be mounted. Provide minimum #4 @ 9" O.C. each way, top and bottom with 1 1/2" cover at top and 3" cover at bottom.

1500 kVA TXFR SLAB AND ANCHOR DESIGN CRITERIA CONTINUED

Anchor loads for Simpson Software model



- Consider LRFD Load Combinations

Wind: 0.9D + 1.0W

Axial = 0.9D = 10575 lb

Shear = $1.0F_w$ = 3135 lb

Overturning Moment = $F_w CGy$ = 11495 lb ft

Seismic: 0.9D - E_v + $\Omega_o E$ Ω_o = 2.0

Axial = 0.9D - E_v = 7989 lb

Shear = $\Omega_o F_p$ = 11638 lb

Overturning Moment = $\Omega_o F_p CGy$ = 42673 lb ft

- Seismic loading controls anchor design.

Provide 3/4" ϕ x 7" minimum embedment ASTM F1554 Grade 36 threaded rod, galvanized, with Simpson Set-3G or approved equal. See Simpson Software calculations.

Company:	Coffman Engineers Inc.	Date:	1/23/2023
Engineer:	JAC	Page:	1/6
Project:	SCCC Transformer and Pad Replacement		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location: Seward, AK
Fastening description: 1500 kVA Transformer Anchors

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 7.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.75
c_{ac} (inch): 14.65
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: Supplementary reinforcement present
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 28.50 x 67.50 x 0.25

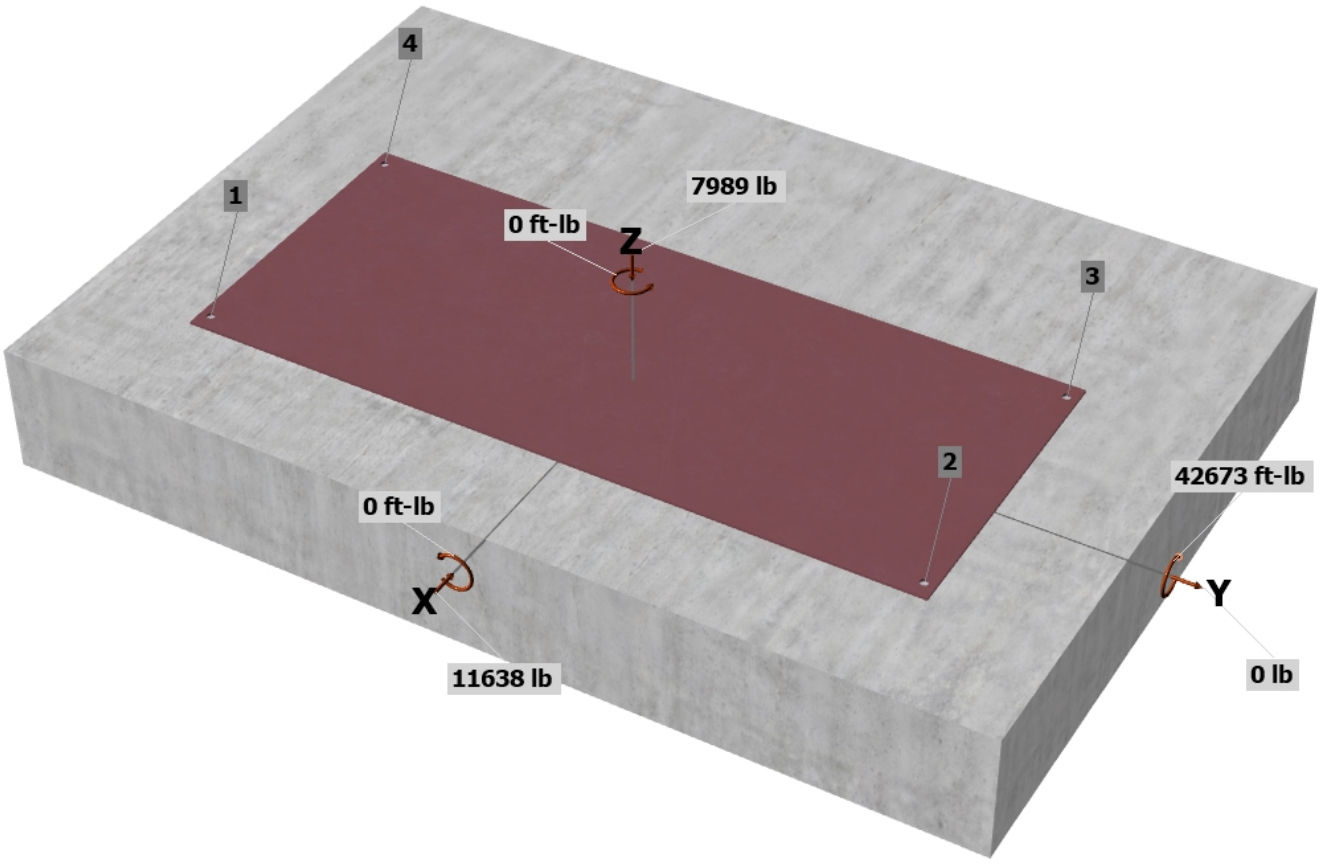
Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 3/4"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.10.5.3 (d) is satisfied
Ductility section for shear: 17.10.6.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: Yes
Anchors only resisting wind and/or seismic loads: Yes

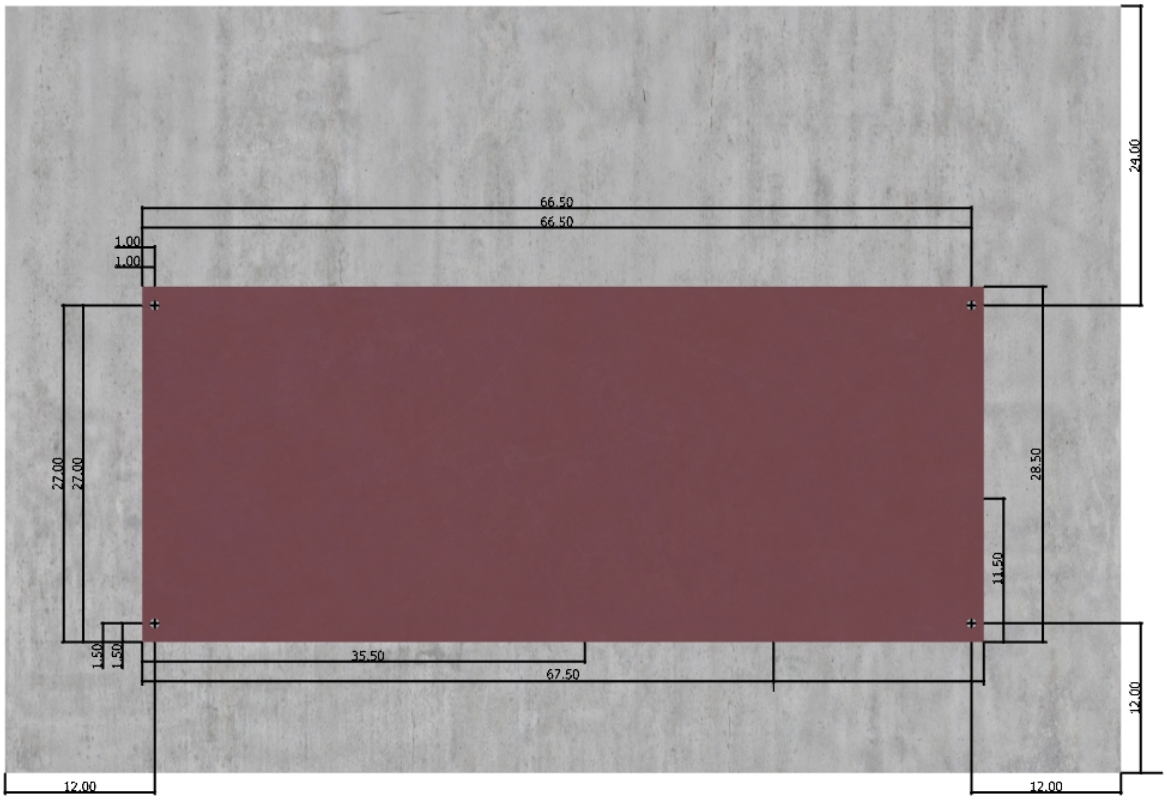
Strength level loads:

N_{ua} [lb]: -7989
V_{uax} [lb]: -11638
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: -42673
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>

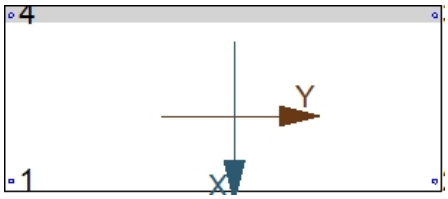

66.50
66.50
1.00
1.00
24.00
27.00
27.00
28.50
11.50
1.50
1.50
35.50
67.50
12.00
12.00

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	7354.8	-2774.5	52.6	2775.0
2	7316.5	-3044.5	52.6	3045.0
3	0.0	-3044.5	-52.6	3045.0
4	0.0	-2774.5	-52.6	2775.0
Sum	14671.3	-11638.0	0.0	11639.9

Maximum concrete compression strain (‰): 0.06
Maximum concrete compression stress (psi): 262
Resultant tension force (lb): 14671
Resultant compression force (lb): 22660
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.09
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

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

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	7.000	17245

$0.75\phi N_{cbg} = 0.75\phi \left(A_{Nc} / A_{Nco}\right) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
882.00	441.00	12.00	0.992	1.000	1.00	1.000	17245	0.75	19243

6. Adhesive Strength of Anchor in Tension (Sec. 17.6.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1310	1.00	1.00	1.00	3000	0.24	1369

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.6.5.2.1)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1369	0.75	7.000	22573

$0.75\phi N_{ag} = 0.75\phi \left(A_{Na} / A_{Na0}\right) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}$ (Sec. 17.5.1.2 & Eq. 17.6.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
844.36	422.18	10.27	12.00	0.992	1.000	1.000	22573	0.65	21826

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11625	1.0	0.65	0.75	5667

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	21.83	50290

$\phi V_{cbgx} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{bx}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
1074.00	2145.13	0.956	0.810	1.000	1.652	50290	0.75	24147

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	12.00	20492

$\phi V_{cbgy} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{by}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
360.00	648.00	1.000	0.900	1.000	1.225	20492	0.75	9411

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	12.00	20492

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{bx}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
666.00	648.00	1.000	1.000	1.000	1.225	20492	0.75	38691

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	12.00	20492

$\phi V_{cbgx} = \phi\ (2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{by}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
720.00	648.00	1.000	1.000	1.000	1.225	20492	0.75	41828

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cp} = \phi \min|k_{cp}N_a\ ;\ k_{cp}N_{cb}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\,\Psi_{ed,Na}\,\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N}N_b|$ (Sec. 17.5.1.2 & Eq. 17.7.3.1a)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	422.18	422.18	1.000	1.000	22573	22573

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ	ϕV_{cp} (lb)
441.00	441.00	1.000	1.000	1.000	17245	17245	0.70	24143

11. Results

Interaction of Tensile and Shear Forces (Sec. R17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	7355	14528	0.51	Pass
Concrete breakout	**14671**	**19243**	**0.76**	**Pass (Governs)**
Adhesive	14671	21826	0.67	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	**3045**	**5667**	**0.54**	**Pass (Governs)**
T Concrete breakout x-	11638	24147	0.48	Pass
T Concrete breakout y+	105	9411	0.01	Pass
|| Concrete breakout y+	6089	38691	0.16	Pass
|| Concrete breakout x+	105	41828	0.00	Pass
Concrete breakout, combined	-	-	0.48	Pass
Pryout	3045	24143	0.13	Pass

Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.8	0.64	0.36	99.1%	1.0	Pass

SET-3G w/ 3/4"Ø F1554 Gr. 36 with hef = 7.000 inch meets the selected design criteria.

12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

SEISMIC DESIGN CRITERIA

SEISMIC DESIGN IS IN ACCORDANCE WITH THE 2021 INTERNATIONAL BUILDING CODE (IBC) AND ASCE 7-16 AS ADOPTED BY THE CITY OF SEWARD. ANALYSIS PROCEDURE IS CHAPTER 13 - NONSTRUCTURAL COMPONENTS.

SPECTRAL RESPONSE VALUES				**ASCE 7-16 REFERENCE**	
RISK CATEGORY		IV		TABLE 1.5-1	
IMPORTANCE FACTOR	Ip =	1.50		SECTION 13.1.3	
0.2 SEC SPECTRAL RESPONSE	Ss =	150%	g	FIGURE 22-1	
SITE CLASS		D - default		TABLE 20.3-1	
SHORT-PERIOD SITE COEFFICIENT	Fa =	1.20		SECTION 11.4.4 OR TABLE 11.4-1	
ADJUSTED SPECTRAL RESPONSE	Sms =	1.80	g	EQUATION 11.4-1	Sms = Fa*Ss
DESIGN SPECTRAL RESPONSE	Sds =	1.20	g	EQUATION 11.4-3	Sds = (2/3)*Sms
SEISMIC DESIGN CATEGORY	SDC =	D		TABLES 11.6-1 & 11.6-2	

SEISMIC DEMAND ON COMPONENT				**ASCE 7-16 REFERENCE**	
COMPONENT DESCRIPTION		300KVA TRANSFORMER		TABLE 13.5-1 OR 13.6-1	
AMPLIFICATION FACTOR	Ap =	1.00		TABLE 13.5-1 OR 13.6-1	
RESPONSE MODIFICATION FACTOR	Rp =	2.50		TABLE 13.5-1 OR 13.6-1	
OVERSTRENGTH FACTOR	Ωo=	2.00		TABLE 13.5-1 OR 13.6-1	
COMPONENT HEIGHT	z =	0.0	FT	SECTION 13.3.1.1	
STRUCTURE HEIGHT	h =	1.0	FT	SECTION 13.3.1.1	
COMPONENT WEIGHT	Wp =	4300	LBS		
	z/h =	0.00		SECTION 13.3.1.1	0 ≤ z/h ≤ 1.0
HORIZONTAL SEISMIC FORCE	Fp =	1238	LBS	EQUATION 13.3-1	Fp = [(0.4*Ap*Sds*Wp)/(Rp/Ip)]*[1+2*(z/h)]
UPPER LIMIT	Fp max =	12384	LBS	EQUATION 13.3-2	Fp ≤ 1.6*Sds*Ip*Ip
LOWER LIMIT	Fp min =	2322	LBS	EQUATION 13.3-3	Fp ≥ 0.3*Sds*Ip*Wp

HORIZONTAL SEISMIC FORCE	**USE Fp =**	**2322**	**LBS**	
CONCURRENT VERTICAL FORCE		**1032**	**LBS**	SECTION 13.3.1.2 0.2*Sds*Wp

COFFMAN ENGINEERS

project	**SCCC TRANSFORMER AND PAD REPLAC**	by	**JAC**	sheet no.
location	**SEWARD, AK**	date	**FEB 2023**	
client	**ALASKA DEPARTMENT OF CORRECTION**	checked	**0**	job no.
topic	**SEISMIC LOAD ON COMPONENT**	date	**FEB 2023**	**222793**

300 kVA TXFR SLAB AND ANCHOR DESIGN CRITERIA

- Eaton 300 kVA, pad-mounted transformer

D = 3620 lb

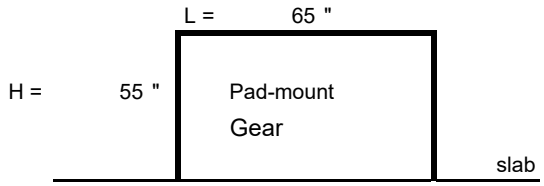
Seismic Load See seismic demand on non-structural component calculation sheet

F_p = 2322 lb

E_v = ± 1032 lb

Wind Load

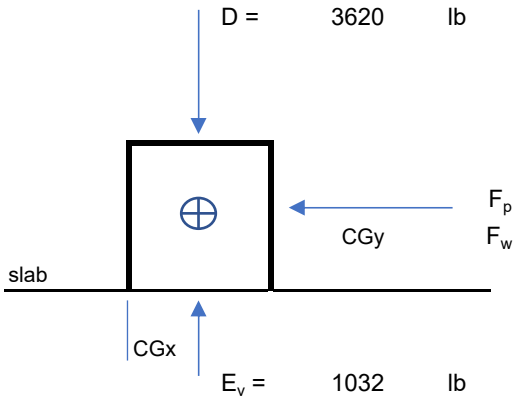
q_z =	57.2	psf	See wind velocity pressure calculation sheet	ASCE 26
A_g =	24.8	ft^2	Project area of non-structural component	ASCE 29.4



G =	0.85		Gust effect factor	ASCE 26.11
C_f =	1.3		Force Coefficient	ASCE Fig. 29-4.1
$F_w = q_z A_g G C_f$ =	1568	lb	Design wind force	ASCE Equ. 29.4-1

300 kVA TXFR SLAB AND ANCHOR DESIGN CRITERIA CONTINUED

Slab loads



CGy = 28 in

CGx = 28 in

Soil properties

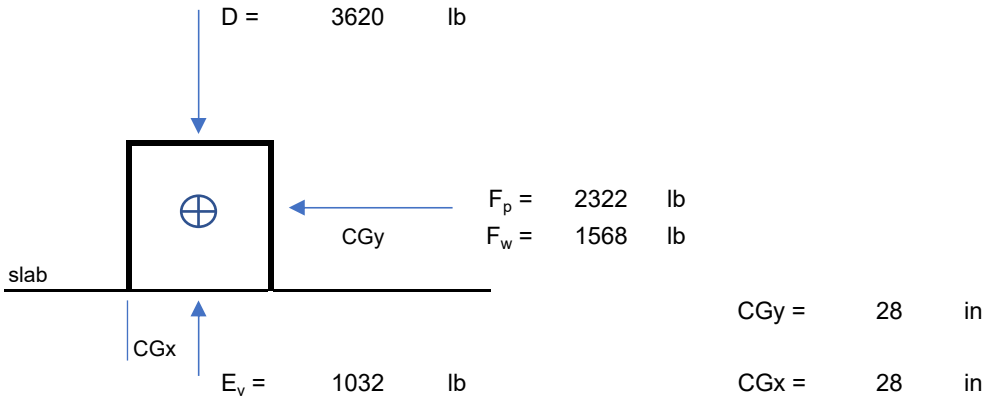
"Subsurface Exploration and Geotechnical Engineering Report" prepared for Spring Creek Correctional Center by R.Z.A. Inc. Geotechnical Consultants, dated July 1984 provided to design team. Specific geotechnical investigation not included in this project. Refer IBC presumptive soil values, Table 1806.2

Bearing Capacity:	2000 psf plus 1/3 for Wind and Seismic loading	
Lateral Bearing Capacity:	150 psf	(assumed)
Coefficient of Friction:	ϕ = 0.25	(assumed)

Provide 12-inch thick foundation slab that is approximately 12" larger in each direction than the equipment to be mounted. Provide #4 @ 9" O.C. each way, top and bottom with 1 1/2" cover at top and 3" cover at bottom.

300 kVA TXFR SLAB AND ANCHOR DESIGN CRITERIA CONTINUED

Anchor loads for Simpson Software model



- Consider LRFD Load Combinations

Wind: 0.9D + 1.0W

Axial = 0.9D = 3258 lb

Shear = $1.0F_w$ = 1568 lb

Overturning Moment = $F_w CGy$ = 3659 lb ft

Seismic: 0.9D - E_v + $\Omega_o E$ Ω_o = 2.0

Axial = 0.9D - E_v = 2226 lb

Shear = $\Omega_o F_p$ = 4644 lb

Overturning Moment = $\Omega_o F_p CGy$ = 10836 lb ft

- Seismic loading controls anchor design.

Provide 3/4" ϕ x 7" minimum embedment ASTM F1554 Grade 36 threaded rod, galvanized, with Simpson Set-3G. See Simpson Software calculations.

Company:	Coffman Engineers, Inc.	Date:	1/23/2023
Engineer:	JAC	Page:	1/6
Project:	SCCC Transformer and Pad Replacement		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location: Seward, AK
Fastening description: 300 kVA Transformer Anchors

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 7.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.75
c_{ac} (inch): 16.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 5000
$\Psi_{c,V}$: 1.0
Reinforcement condition: Supplementary reinforcement present
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 15.00 x 48.00 x 0.25

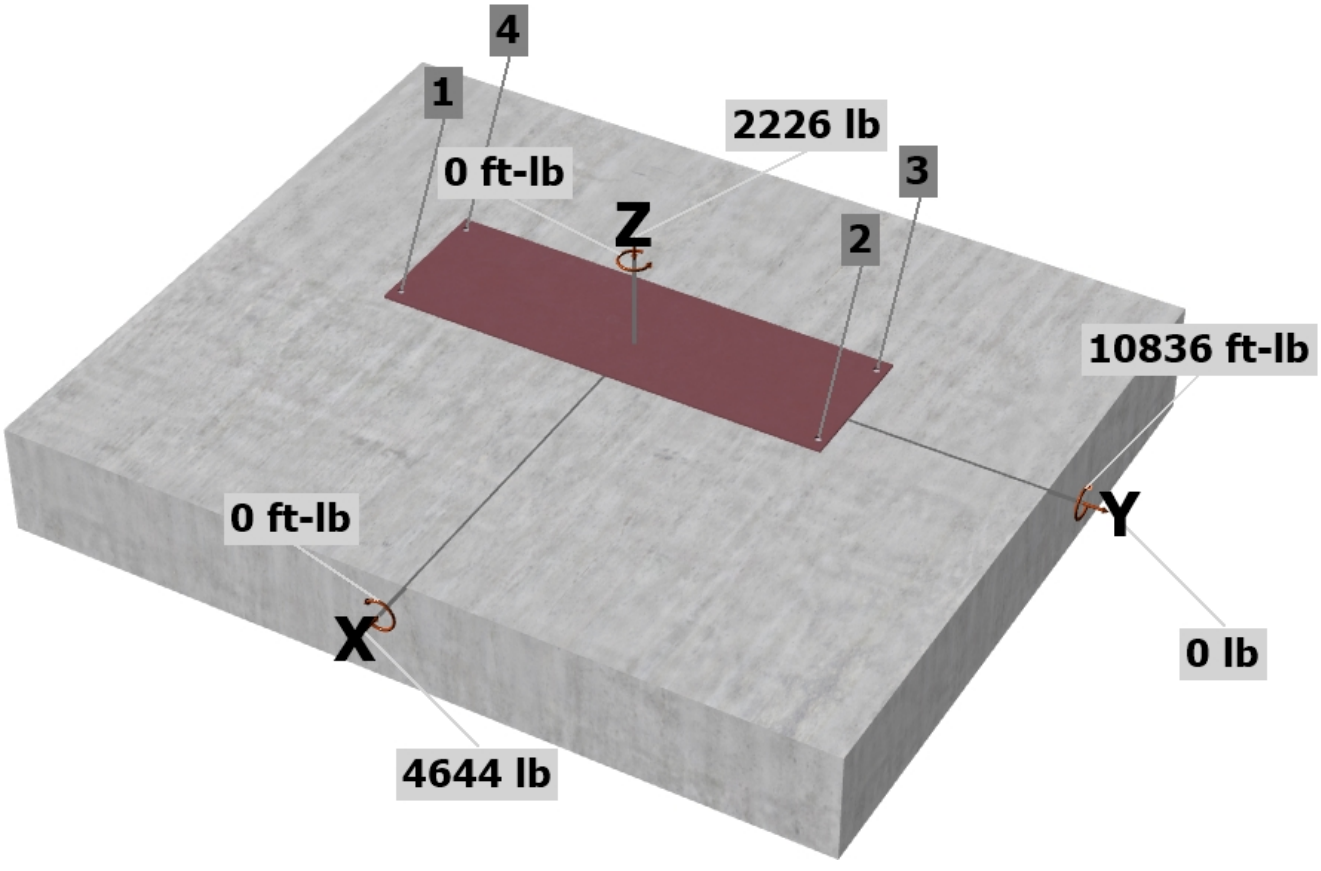
Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 3/4"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.10.5.3 (d) is satisfied
Ductility section for shear: 17.10.6.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: Yes
Anchors only resisting wind and/or seismic loads: Yes

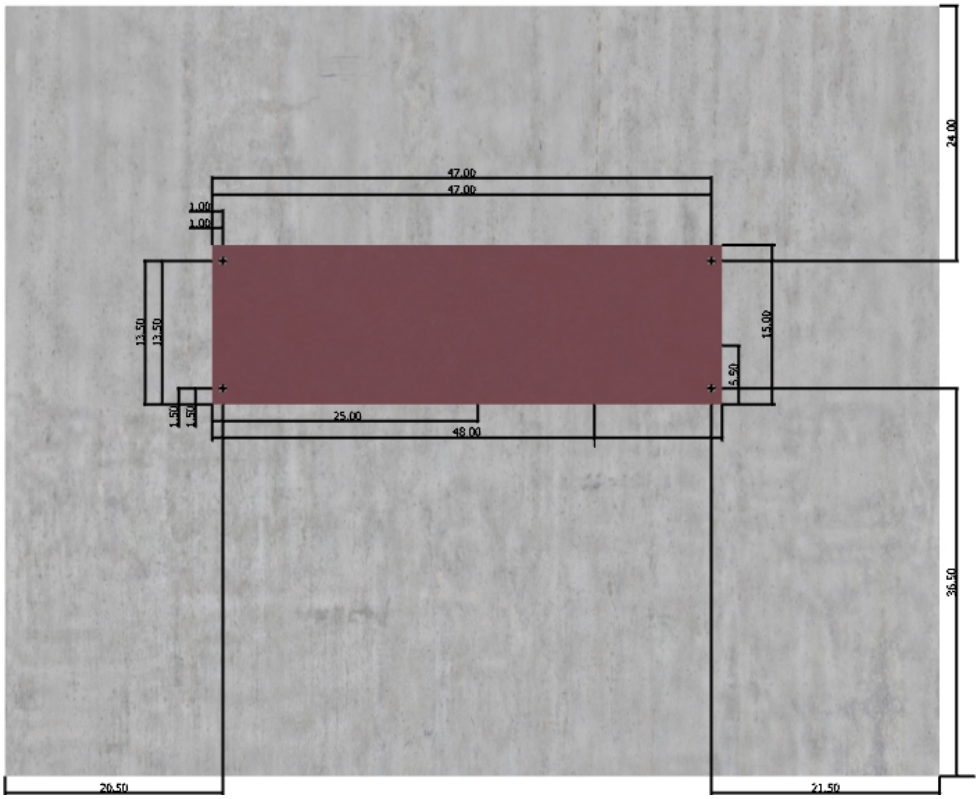
Strength level loads:

N_{ua} [lb]: -2226
V_{uax} [lb]: -4644
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: -10836
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>

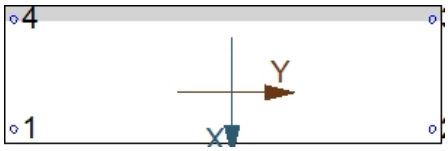

47.00
47.00
1.00
1.00
13.50
13.50
1.50
1.50
25.00
48.00
15.00
5.50
24.00
36.50
20.50
21.50

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	4268.4	-1113.7	12.3	1113.8
2	4255.0	-1208.3	12.3	1208.3
3	0.0	-1208.3	-12.3	1208.3
4	0.0	-1113.7	-12.3	1113.8
Sum	8523.4	-4644.0	0.0	4644.3

Maximum concrete compression strain (‰): 0.06
Maximum concrete compression stress (psi): 263
Resultant tension force (lb): 8523
Resultant compression force (lb): 10749
Eccentricity of resultant tension forces in x-axis, e'$_{Nx}$ (inch): 0.04
Eccentricity of resultant tension forces in y-axis, e'$_{Ny}$ (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'$_{Vx}$ (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'$_{Vy}$ (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

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

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	5000	7.000	22263

$0.75\phi N_{cbg} = 0.75\phi \, (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
882.00	441.00	20.50	0.997	1.000	1.00	1.000	22263	0.75	24960

6. Adhesive Strength of Anchor in Tension (Sec. 17.6.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n \alpha_{N,seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N,seis}$	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1310	1.00	1.00	1.00	5000	0.24	1547

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.6.5.2.1)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1547	0.75	7.000	25517

$0.75\phi N_{ag} = 0.75\phi \, (A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}$ (Sec. 17.5.1.2 & Eq. 17.6.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
844.36	422.18	10.27	20.50	0.997	1.000	1.000	25517	0.65	24792

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11625	1.0	0.65	0.75	5667

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	5000	20.50	59069

$\phi V_{cbgy} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{by}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
657.00	1891.13	1.000	0.934	1.000	1.601	59069	0.75	23015

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	5000	15.33	38210

$\phi V_{cbgx} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{bx}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
1056.00	1058.00	0.961	0.967	1.000	1.384	38210	0.75	36810

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	5000	15.33	38210

$\phi V_{cbgx} = \phi\ (2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{by}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
1056.00	1058.00	1.000	1.000	1.000	1.384	38210	0.75	79200

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	5000	21.50	63443

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{bx}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
819.00	2080.13	1.000	1.000	1.000	1.639	63443	0.75	61425

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cp} = \phi \min|k_{cp}N_a\ ;\ k_{cp}N_{cb}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\,\Psi_{ed,Na}\,\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N}N_b|$ (Sec. 17.5.1.2 & Eq. 17.7.3.1a)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	334.37	422.18	1.000	1.000	25517	20210

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ	ϕV_{cp} (lb)
346.50	441.00	1.000	1.000	1.000	22263	17492	0.70	24489

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	4268	14528	0.29	Pass
Concrete breakout	8523	24960	0.34	Pass
Adhesive	**8523**	**24792**	**0.34**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	**1208**	**5667**	**0.21**	**Pass (Governs)**
T Concrete breakout y-	25	23015	0.00	Pass
T Concrete breakout x-	4644	36810	0.13	Pass
|| Concrete breakout x-	25	79200	0.00	Pass
|| Concrete breakout y+	2417	61425	0.04	Pass
Concrete breakout, combined	-	-	0.13	Pass
Pryout	1208	24489	0.05	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.8.1	0.34	0.00	34.4%	1.0	Pass

SET-3G w/ 3/4"Ø F1554 Gr. 36 with hef = 7.000 inch meets the selected design criteria.

12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Model PME-9

Dimensions in inches (mm)

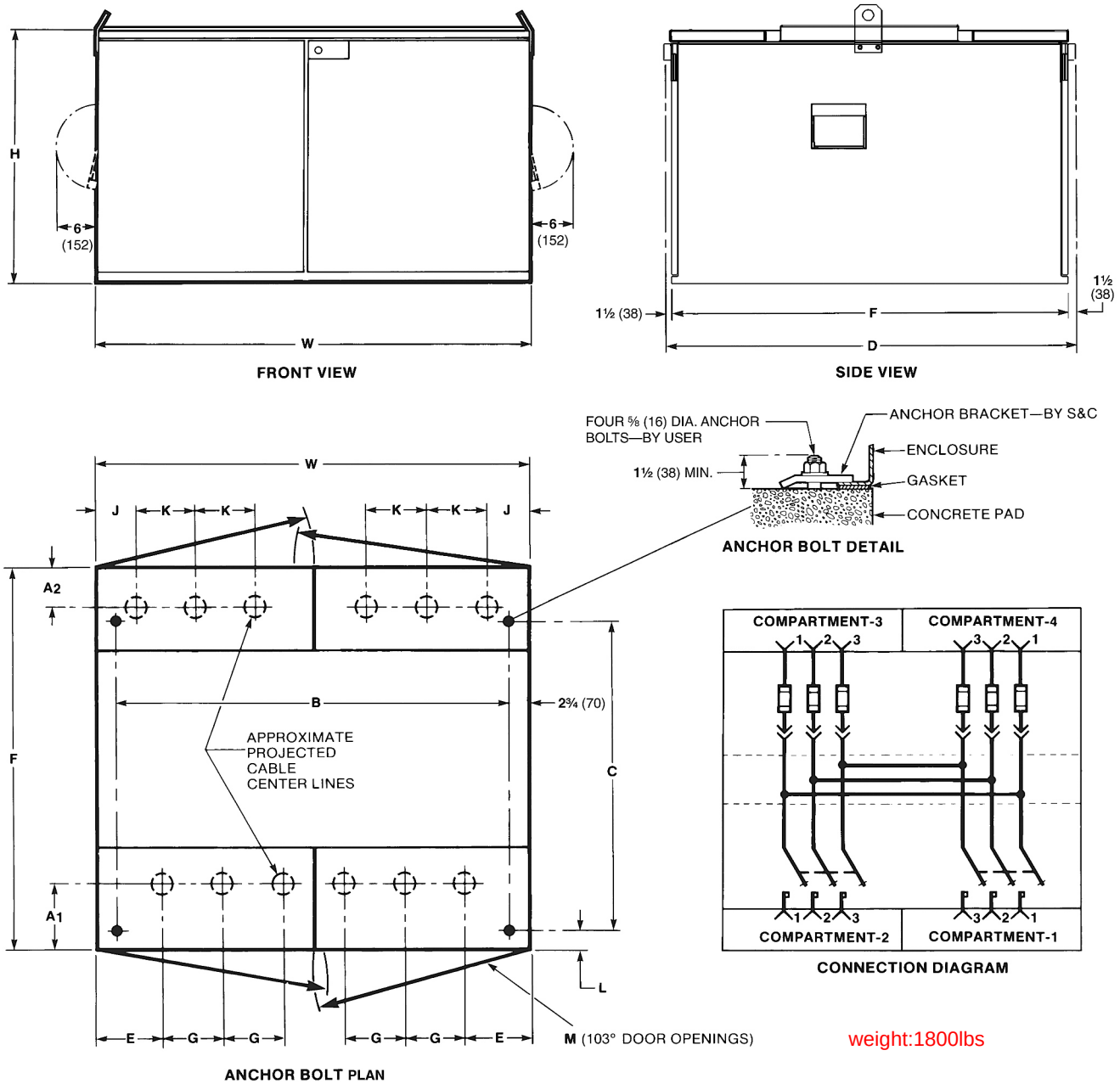


Table 20. Model PME-9 Dimensions

kV, Nominal	A_1◆	A_2◆	B	C	D	E	F	G	H	J	K	L	M	W
14.4	14½ (368)	7 (178)	69½ (1765)	49½ (1257)	69¾ (1772)	12⅜ (314)	66¾ (1695)	8¼ (210)	45½ (1156)	5⅜ (137)	10¾ (273)	8⅝ (219)	38 (965)	75 (1905)
25	18½ (470)	8⅛ (206)	78½ (1994)	52 (1321)	84¾ (2153)	12⅞ (327)	81¾ (2076)	8¼ (210)	51½ (1308)	6 (152)	12 (305)	14⅞ (378)	42½ (1080)	84 (2134)

◆ Projected cable center lines are applicable for PME models with cable installed in a cable pit. For cable installed in conduit, refer to pages 23 and 24.

SEISMIC DESIGN CRITERIA

SEISMIC DESIGN IS IN ACCORDANCE WITH THE 2021 INTERNATIONAL BUILDING CODE (IBC) AND ASCE 7-16 AS ADOPTED BY THE CITY OF SEWARD. ANALYSIS PROCEDURE IS CHAPTER 13 - NONSTRUCTURAL COMPONENTS.

SPECTRAL RESPONSE VALUES				**ASCE 7-16 REFERENCE**	
RISK CATEGORY		IV		TABLE 1.5-1	
IMPORTANCE FACTOR	Ip =	1.50		SECTION 13.1.3	
0.2 SEC SPECTRAL RESPONSE	Ss =	150%	g	FIGURE 22-1	
SITE CLASS		D - default		TABLE 20.3-1	
SHORT-PERIOD SITE COEFFICIENT	Fa =	1.20		TABLE 11.4-1	
ADJUSTED SPECTRAL RESPONSE	Sms =	1.80	g	EQUATION 11.4-1	Sms = Fa*Ss
DESIGN SPECTRAL RESPONSE	Sds =	1.20	g	EQUATION 11.4-3	Sds = (2/3)*Sms
SEISMIC DESIGN CATEGORY	SDC =	D		TABLES 11.6-1 & 11.6-2	

SEISMIC DEMAND ON COMPONENT				**ASCE 7-16 REFERENCE**	
COMPONENT DESCRIPTION	PAD-MOUNT SWITCH			TABLE 13.5-1 OR 13.6-1	
AMPLIFICATION FACTOR	Ap =	2.50		TABLE 13.5-1 OR 13.6-1	
RESPONSE MODIFICATION FACTOR	Rp =	6.00		TABLE 13.5-1 OR 13.6-1	
OVERSTRENGTH FACTOR	Ωo=	2.00		TABLE 13.5-1 OR 13.6-1	
COMPONENT HEIGHT	z =	0.0	FT	SECTION 13.3.1.1	
STRUCTURE HEIGHT	h =	1.0	FT	SECTION 13.3.1.1	
COMPONENT WEIGHT	Wp =	1800	LBS		
	z/h =	0.00		SECTION 13.3.1.1	0 ≤ z/h ≤ 1.0
HORIZONTAL SEISMIC FORCE	Fp =	540	LBS	EQUATION 13.3-1	Fp = [(0.4*Ap*Sds*Wp)/(Rp/Ip)]*[1+2*(z/h)]
UPPER LIMIT	Fp max =	5184	LBS	EQUATION 13.3-2	Fp ≤ 1.6*Sds*Ip*Ip
LOWER LIMIT	Fp min =	972	LBS	EQUATION 13.3-3	Fp ≥ 0.3*Sds*Ip*Wp

HORIZONTAL SEISMIC FORCE	**USE Fp =**	**972**	**LBS**	
CONCURRENT VERTICAL FORCE		**432**	**LBS**	SECTION 13.3.1.2 0.2*Sds*Wp

COFFMAN ENGINEERS

project	**SCCC TRANSFORMER AND PAD REPLAC**	by	**JAC**	sheet no.
location	**SEWARD, AK**	date	**FEB 2023**	
client	**ALASKA DEPARTMENT OF CORRECTION**	checked	**0**	job no.
topic	**SEISMIC LOAD ON COMPONENT**	date	**FEB 2023**	**222793**

SWITCH GEAR SLAB AND ANCHOR DESIGN CRITERIA

- Pad-mounted Gear, S&C PME-9

D = 1800 lb

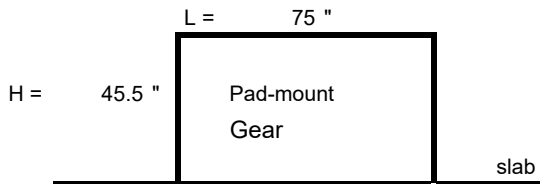
Seismic Load See seismic demand on non-structural component calculation sheet

F_p = 972 lb

E_v = ± 432 lb

Wind Load

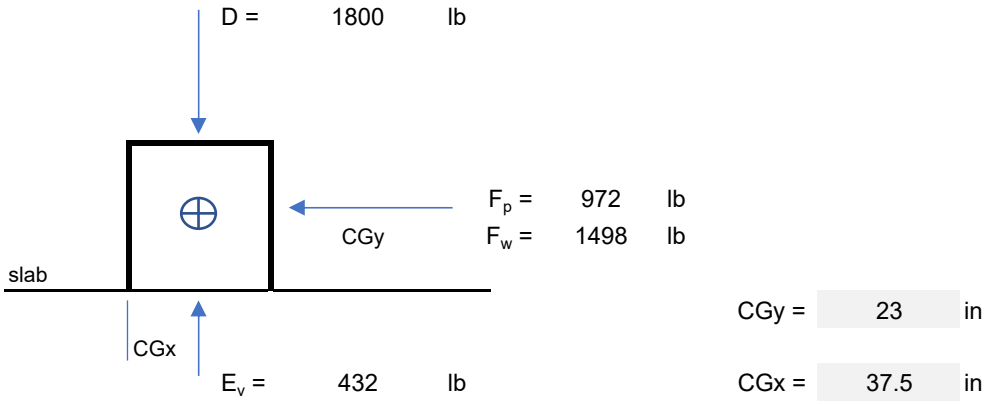
q_z =	57.2	psf	See wind velocity pressure calculation sheet	ASCE 26
A_g =	23.7	ft^2	Project area of non-structural component	ASCE 29.4



G =	0.85		Gust effect factor	ASCE 26.11
C_f =	1.3		Force Coefficient	ASCE Fig. 29-4.1
$F_w = q_z A_g G C_f$ =	1498	lb	Design wind force	ASCE Equ. 29.4-1

SWITCH GEAR SLAB AND ANCHOR DESIGN CRITERIA CONTINUED

Slab loads



Soil properties

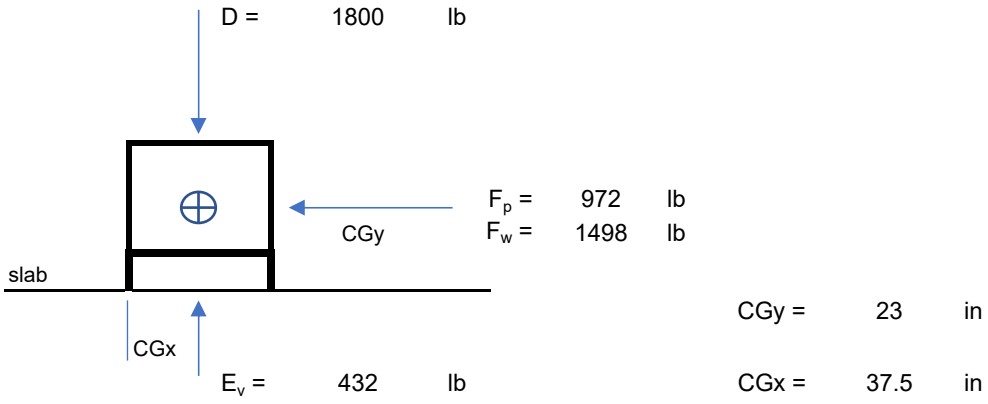
"Subsurface Exploration and Geotechnical Engineering Report" prepared for Spring Creek Correctional Center by R.Z.A. Inc. Geotechnical Consultants, dated July 1984 provided to design team. Specific geotechnical investigation not included in this project. Refer IBC presumptive soil values, Table 1806.2

Bearing Capacity:	2000 psf plus 1/3 for Wind and Seismic loading	
Lateral Bearing Capacity:	150 psf	(assumed)
Coefficient of Friction:	ϕ = 0.25	(assumed)

Provide 12-inch thick foundation slab that is approximately 6" larger in each direction than the equipment to be mounted. Provide #4 @ 9" O.C. each way, top and bottom with 1 1/2" cover at top and 3" cover at bottom.

SWITCH GEAR SLAB AND ANCHOR DESIGN CRITERIA CONTINUED

Anchor loads for Simpson Software model



- Consider LRFD Load Combinations

Wind: 0.9D + 1.0W

Axial = 0.9D = 1620 lb

Shear = $1.0F_w$ = 1498 lb

Overturning Moment = $F_w CGy$ = 2871 lb ft

Seismic: 0.9D - E_v + $\Omega_o E$ Ω_o = 2.0

Axial = 0.9D - E_v = 1188 lb

Shear = $\Omega_o F_p$ = 1944 lb

Overturning Moment = $\Omega_o F_p CGy$ = 3726 lb ft

- Seismic loading controls anchor design.

Provide 5/8" ϕ x 4" minimum embedment ASTM F1554 Grade 36 threaded rod, galvanized, with Simpson Set-3G. See Simpson Software calculations.

Company:	Coffman Engineers, Inc.	Date:	3/30/2023
Engineer:	BMH	Page:	1/6
Project:	SCCC Transformer and Pad Replacement		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location: Seward, AK
Fastening description: Change Gear Cabinet Anchors

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 4.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 5.38
c_{ac} (inch): 9.62
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 6.00
State: Cracked
Compressive strength, f'_c (psi): 5000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 53.50 x 73.75 x 0.25

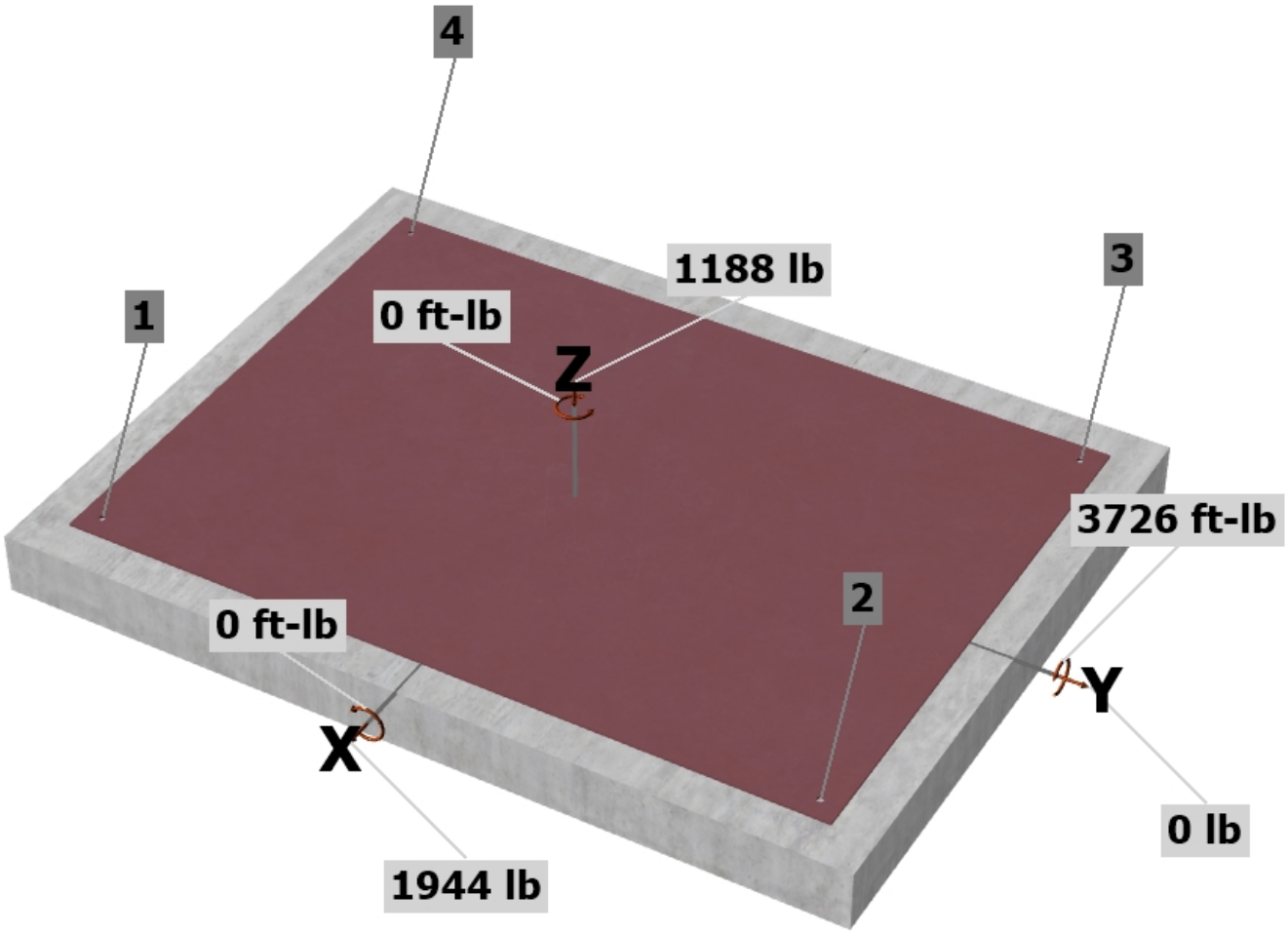
Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 5/8"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.2 not applicable
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

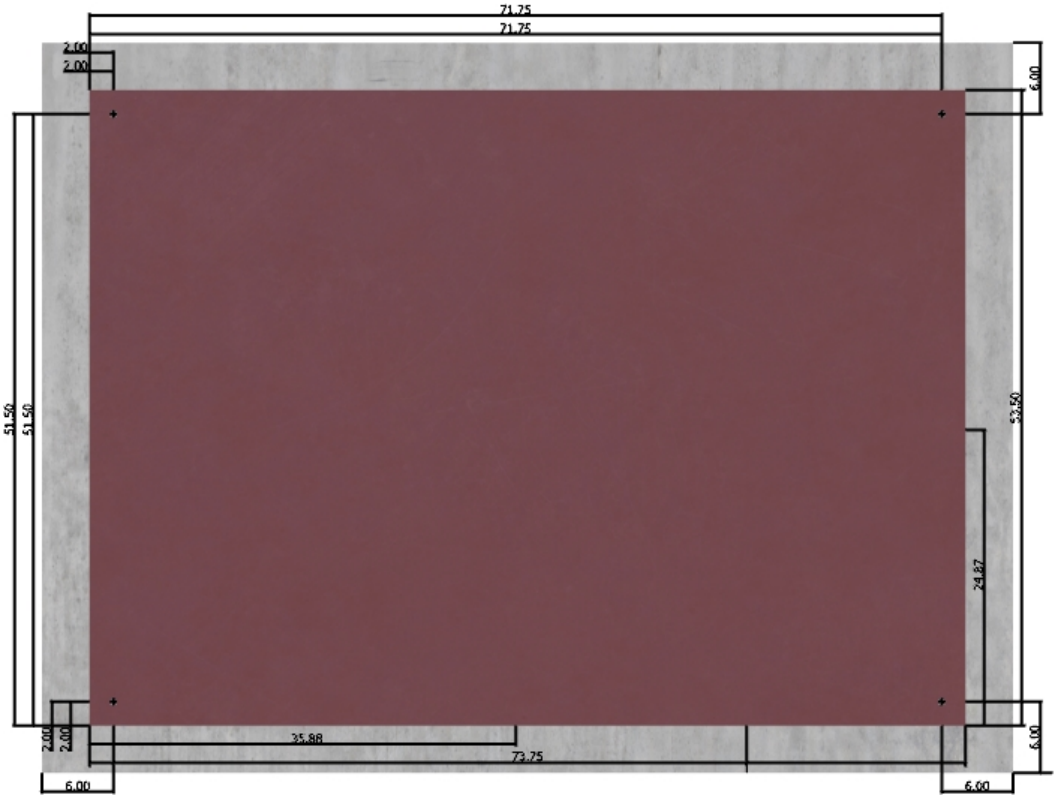
Strength level loads:

N_{ua} [lb]: -1188
V_{uax} [lb]: 1944
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 3726
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>

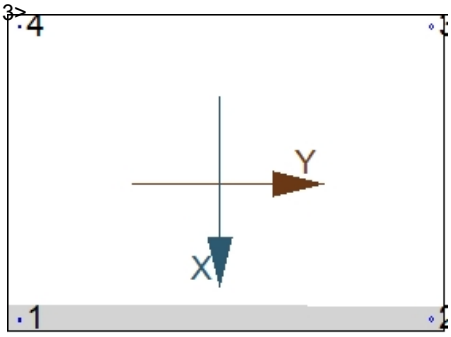

71.75
71.75
2.00
2.00
6.00
51.50
51.50
53.50
24.87
2.00
2.00
35.88
73.75
6.00
6.00
6.00

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	495.2	6.5	495.3
2	0.0	476.8	6.5	476.8
3	169.2	476.8	-6.5	476.8
4	168.3	495.2	-6.5	495.3
Sum	337.4	1944.0	0.0	1944.2

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 10
Resultant tension force (lb): 337
Resultant compression force (lb): 1525
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.09
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
13110	0.75	9833

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	5000	4.000	9617

$0.75\phi N_{cbg} = 0.75\phi (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
288.00	144.00	6.00	0.985	1.000	1.00	1.000	9617	0.65	9233

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n \alpha_{N,seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N,seis}$	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1356	1.00	1.00	1.00	5000	0.24	1601

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1601	0.63	4.000	12578

$0.75\phi N_{ag} = 0.75\phi (A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
435.84	307.10	8.76	6.00	0.989	0.905	1.000	12578	0.65	7796

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
7865	1.0	0.65	0.75	3834

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
4.00	0.625	1.00	5000	6.00	8337

$\phi V_{cbgy} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
90.00	162.00	1.000	0.900	1.000	1.225	8337	0.70	3574

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
4.00	0.625	1.00	5000	6.00	8337

$\phi V_{cbgx} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
180.00	162.00	0.932	0.900	1.000	1.225	8337	0.70	6658

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
4.00	0.625	1.00	5000	6.00	8337

$\phi V_{cbgx} = \phi\ (2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
180.00	162.00	1.000	1.000	1.000	1.225	8337	0.70	15882

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
4.00	0.625	1.00	5000	6.00	8337

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
180.00	162.00	1.000	1.000	1.000	1.225	8337	0.70	15882

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi \min|k_{cp}N_a\ ;\ k_{cp}N_{cb}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\,\Psi_{ed,Na}\,\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	217.92	307.10	0.905	1.000	12578	8081

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ	ϕV_{cp} (lb)
144.00	144.00	1.000	1.000	1.000	9617	9617	0.70	11313

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	169	9833	0.02	Pass
Concrete breakout	337	9233	0.04	Pass
Adhesive	**337**	**7796**	**0.04**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	495	3834	0.13	Pass
T Concrete breakout y+	7	3574	0.00	Pass
T Concrete breakout x+	972	6658	0.15	Pass
|| Concrete breakout x+	13	15882	0.00	Pass
|| Concrete breakout y-	990	15882	0.06	Pass
Concrete breakout, combined	**-**	**-**	**0.15**	**Pass (Governs)**
Pryout	495	11313	0.04	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6.2	0.00	0.15	14.6%	1.0	Pass

SET-3G w/ 5/8"Ø F1554 Gr. 36 with hef = 4.000 inch meets the selected design criteria.

12. Warnings

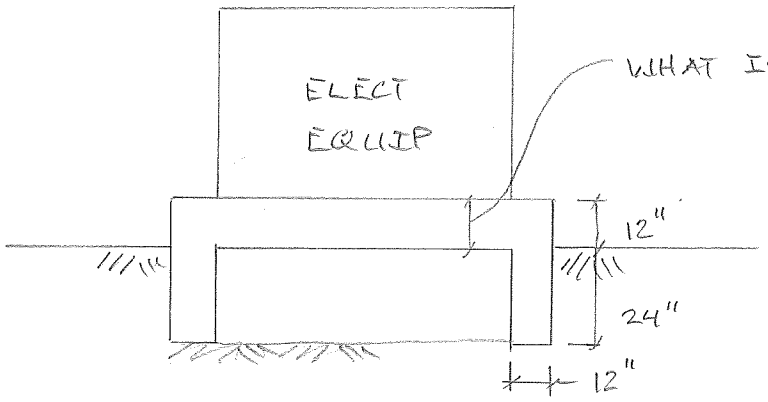
- Per designer input, the tensile component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor tensile force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.4.2 for tension need not be satisfied – designer to verify.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

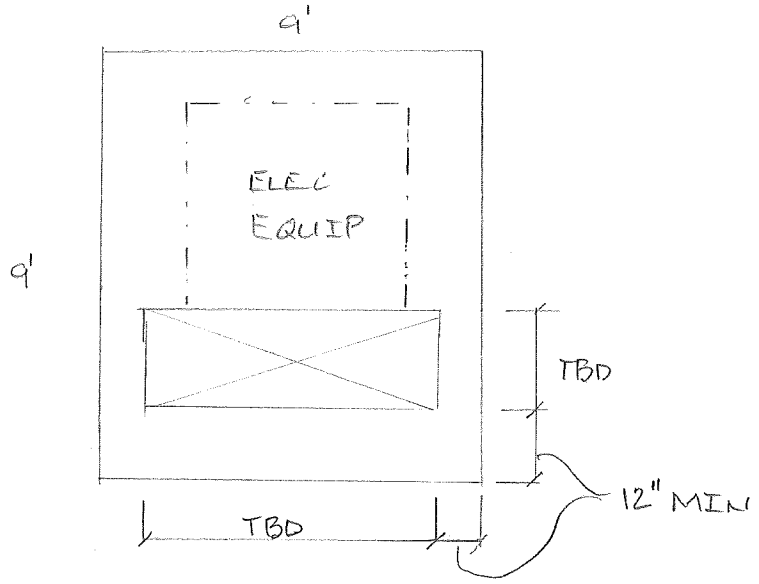
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

PRECAST TRANSFORMER PAD



WHAT IS MIN t?

NEED 12" FOR ANCHORS, MIN.



WHAT IS MIN THICKNESS AND REINFORCEMENT FOR CONCRETE SPAN?

1500 KVA XFMR 11,800 lb

LOADED AREA => 65" x 35" = 15.8 ft²

DL = 11800 lb / 15.8 ft² = 750 PSF

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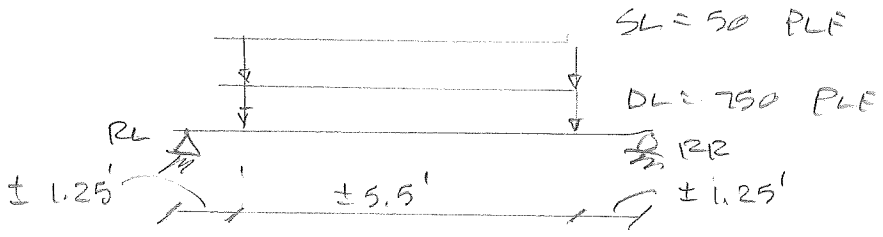
project SCCC TRANFORMER PAD	by JAC	sheet no. 1
location	date 2/1/23	
client	checked	Job no.
	date	

PRECAST TRANSFORMER PAD CONT'D

SL = 50 PSF , SELF-WT = 150 PSF

CONSIDER 12" TRIB WIDTH , 8' SPAN :



$1.2\,DL + 1.6\,SL = 1.2(750 + 150) + 1.6(50) = 1160$ PLF

$F_y = 0 \uparrow$

$R_L + R_R - 1160\ PLF\ (5.5') = 0$, $R_L = R_R$

$2R = 6380$ lb $\qquad R = R_L = R_R = 3190$ lb

AISC TABLE 3-23

$a = c = 1.25'$ $\qquad b = 5.5'$, $\qquad x = 4'$

$$M_{MAX} = R_L\left(a + \frac{R_L}{2w}\right) = 3190\ lb\left[1.25' + \frac{3190\ lb}{2(1160\ PLF)}\right]$$

$= 8374$ lb ft

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project SCCC TRANSFORMER PAD	by JAC	sheet no. 2
location	date 2/1/23	
client	checked	Job no.
	date	

PRECAST TRANSFORMER PAD CONT'D

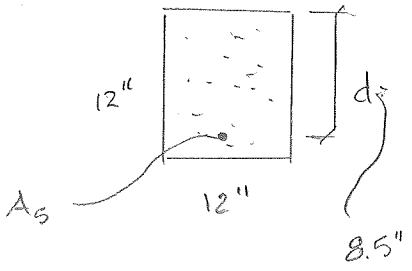
CHECK SHEAR: ACI 22.5.5.1

PRECAST CONC

$\phi V_c = \phi 2 \sqrt{f'_c}\, b d$ $\quad \phi = .75$

$= .75(2)\sqrt{5000}\,(12")(8.375")$

$= 9534$ lb $>$ R = 3190 lb OK.



CHECK MOMENT: ACI 22.4.2.2.

$$A_{s\,REQ} = \frac{M_u}{\phi f_y (d - a/2)} \qquad \text{LET } a = .5"$$

$$= \frac{8374 \text{ lb ft } (12)}{.90(60000)\,(8.5" - .5"/2)} = .22 \text{ in}^2$$

TRY #3 @ 6" o.c. $\Rightarrow$ .22 in²/ft

$\longrightarrow$ #4 @ 9" o.c. $\Rightarrow$ .26 in²/ft

✓ a: $a = \frac{A_s f_y}{.85 f'_c b} = \frac{.26 \text{ in}^2\,(60 \text{ ksi})}{.85(5 \text{ ksi})(12")}$

$= .31" <$ ASSUMED $a = .5"$ O.K.

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project SCCC TRANSFORMER	by JAC	sheet no. 3
location	date	
client	checked	Job no.
	date	

Spring Creek Correctional Center Transformer Replacement Project

– SPECIFICATIONS –

ISSUED FOR BIDDING

April 27, 2023

Agreement# 230004026

Prepared for:

STATE OF ALASKA, DEPARTMENT OF CORRECTIONS

Prepared by:

COFFMAN ENGINEERS

TABLE OF CONTENTS

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected site elements.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and **deliver to Owner**.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

1.5 INFORMATIONAL SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services.

B. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.8 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review Project Record Documents of existing construction or other existing conditions and information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 1 hour after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.

7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete Foundation: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Transformers, Switch Gear, and Electrical Equipment: Remove electrical equipment, conductors, and conduit as indicated on the plans. Contractor to dispose of removed equipment at an approved off-site location.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site **and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.**

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for concrete, materials, mix designs, placement procedures and finishes.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with the drawings and ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.

3.3 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars.
2. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Concrete Subcontractor.

2. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Anchor rod and anchorage device installation tolerances.
c. Concrete finishes and finishing.
d. Curing procedures.
e. Forms and form-removal limitations.
f. Concrete protection.

g. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
h. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Aggregates.
3. Admixtures:

a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

4. Curing materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Maximum w/cm.
4. Slump limit.
5. Air content.
6. Nominal maximum aggregate size.
7. Intended placement method.
8. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Adhesives.

B. Research/Evaluation Reports: For post-installed anchors.

C. Preconstruction Test Reports: For each mix design.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

C. Field Quality-Control Testing Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Plywood, metal, or other approved materials. Furnish in largest practicable sized to minimize number or joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or other approved material. Provide lumber dress on a least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips 3/4 by 3/4 inch minimum.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to rest lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal close than 1 inch to the plane of the exposed concrete surface.
2. Furnish ties that, when removed, leave holes no large than 1 inch in diameter in concrete surface.

2.3 ANCHORS AND ANCHOR BOLTS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36, of dimensions indicated on the drawings.

1. Configuration: Straight.
2. Nuts: ASTM A563, heavy-hex carbon steel.
3. Plate Washers: ASTM A529 carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel
5. Finish: Hot-dip zinc coating, ASTM A153, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 36, of dimensions indicated on the drawings; with nuts ASTM A563; and hardened carbon steel washers, ASTM F436, Type 1.

1. Configuration: Straight.
2. Nuts: ASTM A563, heavy-hex carbon steel.
3. Plate Washers: ASTM A529 carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel
5. Finish: Hot-dip zinc coating, ASTM A153, Class C.

C. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated on the drawings; galvanize ferrous castings, either ASTM A47 malleable iron or ATM A27 cast steel. Provide bolts, washers, sand shims as needed, all hot-dip galvanized per ASTM F2329.

D. Post-installed Anchors: Torque-controlled expansion anchors or chemical anchors.
   1. Material for interior locations: Carbon-steel components, zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for exterior locations and where stainless steel is indicated: Alloy Group 1 stainless steel bolts, ASTM F593, with nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Grout: Non-shrink, non-metallic, factory packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 CONCRETE MATERIALS

A. Source Limitations:

   1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
   2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
   3. Obtain aggregate from single source.
   4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

   1. Portland Cement: ASTM C150/C150M, Type I, Type II, Type I/II or Type III.

C. Normal-Weight Aggregates: ASTM C33/C33M coarse aggregate or better, graded. Provide aggregates from a single source.

   1. Maximum Coarse-Aggregate Size: 1 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

   1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   2. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

F. Water: ASTM C94, potable.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

D. Water: Potable or complying with ASTM C1602/C1602M.

2.7 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.

2.8 CONCRETE MIXTURES

A. Exterior Slabs, Foundations, and concrete exposed to freezing: Normal-weight concrete.
1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content:

a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. Deposit concrete to avoid segregation.
2. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
3. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
b. Remove projections larger than 1/4 inch.
c. Patch tie holes.
d. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 FINISHING EXTERIOR SLABS AND FOUNDATIONS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Broom Finish: Apply a broom finish to exterior concrete equipment foundations.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Department before application.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.

3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 9 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. If forms remain during curing period, moist cure after loosening forms.
3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    b. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    c. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.

3.9 TOLERANCES

A. Conform to ACI 117.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Department.
2. Remove and replace concrete that cannot be repaired and patched to Department’s approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.
b. Make edges of cuts perpendicular to concrete surface.
c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
d. Fill and compact with patching mortar before bonding agent has dried.
e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Department.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

a. Correct low and high areas.
b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that

penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer’s approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer’s approval.

3.11 FIELD QUALITY CONTROL

A. Special Inspections: The Department will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: The Department will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency to immediately report to Department, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Department, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports to include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Verification of use of required design mixture.
2. Concrete placement, including conveying and depositing.
3. Curing procedures and maintenance of curing temperature.
4. Steel reinforcement placement.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 to be performed in accordance with the following requirements:

1. Testing Frequency: Unless noted otherwise, obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143:

a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/ pressure method, for normal-weight concret.

a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064:

a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31:

a. Cast and laboratory cure two sets of 4-inch by 8-inch cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39.

a. Test one set of three laboratory-cured specimens at seven days and one set of thee specimens at 28 days.
b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
8. Additional Tests:

a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Department.
b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by the Department.

1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

9. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
10. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 034100 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast structural concrete for equipment foundations.

B. Related Requirements:

1. Section 032000 “Concrete Reinforcing” for steel reinforcing bars.
2. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, concrete testing and inspection requirement, and placing connection anchors in concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.

C. Shop Drawings:

1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Welding certificates.

C. Material Certificates: For the following:

1. Cementitious materials.
2. Reinforcing materials.
3. Admixtures.

D. Material Test Reports: For aggregates, by a qualified testing agency.

E. Preconstruction test reports.

F. Source quality-control reports.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Responsibility includes preparation of Shop Drawings.

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

C. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.

B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
2. Place adequate dunnage of even thickness between each unit.
3. Place stored units so identification marks are clearly visible, and units can be inspected.

C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

B. Provide precast structural concrete units as noted on the drawings and to resist handling, transportation, and placement stresses.

2.2 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.3 REINFORCING MATERIALS

A. Reinforcing Bars: Reference ASTM A615/A615M, Grade 60, deformed.

B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 116 and ASTM C33/C33M.

C. Water: ASTM C94, potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

D. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C494/C494M, Type A.
2. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.

2.5 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume,

with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

2.6 CONCRETE MIXTURES

A. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

B. Foundations and concrete exposed to freezing: Normal-weight concrete

1. Compressive Strength (28 Days): 5000 psi.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

C. Exposure Class F1: 5.0 percent, plus or minus, 1.5 percent at the point of delivery for concrete containingg 1-inch nominal maximum aggregate size.

D. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

E. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.7 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Edge and Corner Treatment: Uniformly chamfered, ¾-inch at exposed edges, unless otherwise indicated in the drawings.

2.8 FABRICATION

A. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings without Engineer's approval.

B. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcing steel to maintain cover requirements note on the drawings. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

C. Reinforce precast structural concrete units to resist handling, transportation, and placement stresses.

D. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

E. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

F. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

G. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.

H. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

I. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

J. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.9 FABRICATION TOLERANCES

A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.10 COMMERCIAL FINISHES

A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in. Major or unsightly imperfections, honeycombs, or structural defects are not permitted.

B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

C. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: The Department will engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.

1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

B. Testing: Reference Section 033000 – “Cast-in-Place Concrete” for concrete testing and reporting requirements.

C. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

D. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's or Department’s approval. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Special Inspections: The Department will engage a qualified special inspector to perform field tests and special inspections and prepare testing and inspection reports.

B. Testing Agency: The Department will engage a qualified testing agency to perform tests and inspections.

C. Testing agency will report test results promptly and in writing to Contractor and Engineer.

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, to be performed to determine compliance of replaced or additional work with specified requirements.

3.2 REPAIRS

A. Repair precast structural concrete units if permitted by Architect.

1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

D. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.3 CLEANING

A. Clean mortar, plaster other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete to remove markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034100

SECTION 260513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.

1.3 DEFINITIONS

A. Jacket: A continuous nonmetallic outer covering for conductors or cables.

B. NETA ATS: Acceptance Testing Specification.

C. Sheath: A continuous metallic covering for conductors or cables.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate location of each cable, splice, and termination.

B. Qualification Data: For Installer.

C. Material Certificates: For each type of cable and accessory.

D. Source quality-control reports.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2 and NFPA 70.

C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

A. Cable Type: Type MV 105.

B. Conductor Insulation: Ethylene-propylene rubber.

1. Voltage Rating: As indicated on drawings.
2. Insulation Thickness: 133 percent insulation level.

C. Conductor: Copper or Aluminum.

D. Comply with UL 1072, AEIC CS8, ICEA S-93-639/NEMA WC 74, and ICEA S-97-682, and ICEA S-94-649.

E. Shielding: Copper tape, helically applied over semiconducting insulation shield.

F. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.

1. Circuit Identification: Color-coded tape (black, red, blue) under the metallic shielding.

2.3 CONNECTORS

A. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.

B. Copper-Conductor Connectors: Copper barrel crimped or Aluminum barrel crimped connectors.

2.4 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type connector.
2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.

2.5 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

C. Load-Break Cable Terminators: Elbow-type units with 200-A-load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

D. Dead-Break Cable Terminators: Elbow-type unit with 200-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.

2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

F. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.6 SPLICE KITS

A. Description: For connecting medium voltage cables; type as recommended by cable or splicing kit manufacturer for the application.

B. Standard: Comply with IEEE 404.

C. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, materials, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

1. Combination tape and cold-shrink-rubber sleeve kit with rejacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.

2.7 MEDIUM-VOLTAGE TAPES

A. Description: Electrical grade, insulating tape rated for medium voltage application.

B. Ethylene/propylene rubber-based, 30-mil splicing tape, rated for 130 deg C operation. Minimum 3/4 inch (20 mm) wide.

2.8 ARC-PROOFING MATERIALS

A. Description: Fire retardant, providing arc flash protection.

B. Tape for First Course on Metal Objects: 10-mil- thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

C. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, and compatible with cable jacket.

D. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch wide.

2.9 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches on the pull rope.

1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Install direct-buried cables on leveled and tamped bed of 3-inch- thick, clean sand. Separate cables crossing other cables or piping by a minimum of 2 inches of tamped earth, plus an additional 2 inches of sand. Install permanent markers at ends of cable runs, changes in direction, and buried splices.

F. Install "buried-cable" warning tape 12 inches above cables.

G. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

H. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

I. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.

J. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
3. Standoff Insulator: At each terminal junction, with one on each terminal.

K. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.
2. Wrap metallic cable components with 10-mil pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
5. Band arc-proofing tape with two layers of 1-inch- wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.

L. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

M. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
3. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.
4. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.

C. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260513

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Conductor Insulation:
1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
5. Type XHHW-2: Comply with UL 44.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper or Bronze.
2. Type: Two hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

D. Cables will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency and testing agency's field supervisor.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.

K. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal clamp.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches (750 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

D. Conductor Terminations and Connections:
1. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
2. Connections to Ground Rods at Test Wells: Bolted connectors.
3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.
3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
3. Substations and Pad-Mounted Equipment: 5 ohms.

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Precast concrete handholes.
6. Polymer concrete handholes and boxes with polymer concrete cover.
7. Fiberglass handholes and boxes with polymer concrete cover.
8. Fiberglass handholes and boxes.
9. High-density plastic boxes.
10. Utility structure accessories.

1.3 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.

2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes, boxes, and other utility structures.
4. Include underground-line warning tape.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

a. Include plans, elevations, sections, details, attachments to other work, and accessories.
b. Include duct entry provisions, including locations and duct sizes.
c. Include reinforcement details.
d. Include grounding details.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1.8 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than 7 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

C. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct and duct bank with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Owner if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into equipment pads with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will match up with equipment pad openings.

C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

A. Duct for Electrical Cables More Than 600 V: Type EPC-80-PVC or Type EPC-40-PVC RNC, unless otherwise indicated.

B. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC or Type EPC-40-PVC RNC, unless otherwise indicated.

C. Underground Ducts Crossing Roadways: Type EPC-40 PVC RNC, encased in reinforced concrete.

D. Stub-ups: Concrete-encased PVC-coated GRC.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Replace area immediately after backfilling is completed.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

3.4 DUCT AND DUCT-BANK INSTALLATION

A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.

B. Install duct according to NEMA TCB 2.

C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.

D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.

E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.

F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. Pulling Cord: Install 200-lbf- test nylon cord in empty ducts.

H. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 12 inches wider than duct on each side.
3. Width: Excavate trench 3 inches wider than duct on each side.
4. Depth: Install top of duct at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
8. Install duct with a minimum of 3 inches Between ducts for like services and 6 inches between power and communications duct.
9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.

    a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

        1) Stub-ups shall be minimum 4 inches abovefinished floor and minimum 3 inches from conduit side to edge of slab.

11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.

I. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches above all concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 260543

SECTION 261213 - LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes liquid-filled, medium-voltage substation transformers, with primary and secondary bushings within or without air-terminal enclosures.

1.3 DEFINITIONS

A. BIL: Basic Impulse Insulation Level.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For liquid-filled, medium-voltage transformers.

1. Include plans and elevations showing major components and features.

    a. Include a plan view and cross section of equipment base, showing clearances, manufacturer's recommended workspace, and locations of penetrations for grounding and conduits.

2. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include single-line diagram.
4. Include list of materials.
5. Include nameplate legends.

C. Transformer Vacuum Fault Interrupter (VFI) settings report.
1. Include settings report for transformer VFI provided by a qualified professional engineer.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings for Outdoor Installations:

1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For transformer assembly, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For transformers, signed by product manufacturer.

E. Source quality-control reports.

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2.

C. Comply with IEEE C57.12.00.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: The transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified."

B. Windings Material: Aluminum or Copper.

C. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, connected in each phase of incoming circuit and ahead of any disconnecting device.

D. Winding Connections: The connection of windings and terminal markings shall comply with IEEE C57.12.70.

E. Efficiency: Comply with 10 CFR 431, Subpart K.

F. Insulation:

1. Transformer kVA Rating Shall Be as Follows: The average winding temperature rise above ambient temperature shall not exceed 65 deg C and 80 deg C hottest-spot temperature rise at rated kVA when tested according to IEEE C57.12.90, using combination of connections and taps that give the highest average winding temperature rise.
2. without decreasing rated transformer life. The rating shall conform to the requirements of IEEE C57.12.90.

G. Bushings shall comply with IEEE C57.19.01 requirements for impulse and low-frequency insulation levels.

H. Tap Changer: External, for de-energized operation.

I. Mounting: An integral skid mounting frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.

J. Insulating Liquids:
1. Less-Flammable Liquids:

a. Edible-Seed-Oil-Based Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D92. Liquid shall be biodegradable and nontoxic, having passed the Organisation for Economic Co-operation and Development G.L.203 with zero mortality, and shall be certified by the U.S. Environmental Protection Agency as biodegradable, meeting Environmental Technology Verification requirements.
b. Biodegradable and Nontoxic Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D92.

c. Silicone-Based Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D92. Liquid shall have low toxicity and be nonhazardous.

K. Sound level shall comply with NEMA TR 1 requirements.

L. Capacities and Characteristics:

1. Location: Outdoors.
2. Comply with UL listing requirements for combination classification and listing for transformer and less-flammable insulating liquid.
3. Service Conditions: Transformers shall be suitable for operation under service conditions specified as usual service conditions in IEEE C57.12.00, except for the following:
   a. Cooling air or water temperature exceeds limits.
   b. Excessive load current harmonic factor.
   c. Operation above rated voltage or below rated frequency.
   d. Exposure to fumes, vapors, or dust.
   e. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
   f. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
   g. Exposure to excessively high or low temperatures.
4. Connections:
   a. Primary: Air-filled terminal cabinet for cable connection.
   b. Secondary: Air-filled terminal cabinet for cable connection.
5. Transformer Ratings. Comply with IEEE C57.12.00 for cooling class.
   a. Self-Cooled Rating, Class KNAN.
   b. Impedance: Not less than 5.75 percent.
   c. Temperature Rise: 65 deg C.
   d. Coils Connection:
      1) High-Voltage Winding: Wye.
      2) Low-Voltage Winding: Wye.
   e. Voltage and BIL Ratings:
      1) Nominal primary phase-to-phase voltage and BIL: For 4160 V, 60 kV. For 13,800 V, 95 kV.
      2) Nominal secondary voltage and BIL: For 480Y/277 V, 45 kV.
   f. .
6. Outdoor Transformer Enclosure Finish: Factory-applied finish in manufacturer's standard color, corrosion resistance complying with IEEE C57.12.28.
7. Taps: Two 2-1/2-percent, full-capacity taps above, and two 2-1/2-percent, full-capacity taps below rated voltage. Comply with IEEE C57.12.36 requirements.
8. Transformer Accessories:

a. Drain and filter connection.
b. Filling and top filter press connections.
c. Pressure-vacuum gauge.
d. Dial-type analog thermometer with alarm contacts.
e. Magnetic liquid level indicator with high and low alarm contacts.
f. Pressure-relief device set to operate at 10 psig, plus or minus 2 psig, and then automatically reseal when pressure drops to 6 psig minimum. Device flow shall be as recommended by manufacturer. With alarm contacts and a manual bleeder.
g. At least four stainless-steel ground connection pads.
h. Provisions for jacking, lifting, and towing.
i. Machine-engraved nameplate made of anodized aluminum or stainless steel.

2.3 WARNING LABELS AND SIGNS

A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

1. Warning signs shall be made of baked enamel.
2. Equipment Identification Labels: Engraved, laminated-acrylic or -melamine label.

2.4 SOURCE QUALITY CONTROL

A. Provide manufacturer's certificate verifying the transformer design tests comply with IEEE C57.12.90.

B. Perform the following factory-certified routine tests on each transformer for this Project:

1. Resistance.
2. Turns ratio, polarity, and phase relation.
3. Transformer no-load losses and excitation current at 100 percent of ratings.
4. Transformer impedance voltage and load loss.
5. Operation of all devices.
6. Control (auxiliary) and consumption losses.
7. Lightning impulse.
8. Low frequency.
9. Leak.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine liquid-filled, medium-voltage transformers upon delivery.

1. Upon delivery of transformers and prior to unloading, inspect equipment for any damage that may have occurred during shipment or storage.

2. Verify that tie rods and chains are undamaged and tight, and that all blocking and bracing is tight. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
3. Verify that there is no indication of external damage and no dents or scratches in doors and sill, tank walls, radiators and fins, or termination provisions.
4. Verify that there is no evidence of insulating-liquid leakage on transformer surfaces, at weld seams, on high- or low-voltage bushing parts, and at transformer base.
5. Verify that there is positive pressure or vacuum on the tank. Check the pressure gauge; it is required to read other than zero.
6. Compare transformers and accessories received with bill of materials to verify that shipment is complete. Verify that transformers and accessories conform with manufacturer's quotation and shop drawings. If shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
7. Verify presence of polychlorinated biphenyl content labeling.
8. Unload transformers carefully, observing all packing label warnings and handling instructions.
9. Open termination compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

1. Handle transformers carefully, in accordance with manufacturer recommendations, to avoid damage to enclosure, termination compartments, base, frame, tank, and internal components. Do not subject transformers to impact, jolting, jarring, or rough handling.
2. Protect transformer termination compartments against entrance of dust, rain, and snow.
3. Transport transformers upright, to avoid internal stresses on core and coil mounting assembly and to prevent trapping air in the windings. Do not tilt or tip transformers.
4. Verify that transformer weights are within rated capacity of handling equipment.
5. Use only manufacturer-recommended points for lifting, jacking, and pulling. Use all lifting lugs when lifting transformers.
6. Use jacks only at corners of tank base plate.
7. Use nylon straps of same length to balance and distribute weight when handling transformers with a crane.
8. Use spreaders or a lifting beam to obtain a vertical lift and to protect transformer from straps bearing against enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
9. Exercise care not to damage tank base structure when handling transformer using skids or rollers. Use skids to distribute stresses over tank base when using rollers under large transformers.

C. Storage:

1. Store transformers in accordance with manufacturer's recommendations.
2. Transformers may be stored outdoors. If possible, store transformers at final installation locations on concrete pads. If dry concrete surfaces are unavailable, use pallets of adequate strength to protect transformers from direct contact with ground. Ensure transformer is level.
3. Ensure that transformer storage location is clean and protected from severe conditions. Protect transformers from dirt, water, contamination, and physical damage. Do not store

transformers in presence of corrosive or explosive gases. Protect transformers from weather when stored for more than three months.

4. Store transformers with compartment doors closed.
5. Regularly inspect transformers while in storage and maintain documentation of storage conditions, noting any discrepancies or adverse conditions. Verify that an effective pressure seal is maintained using pressure gauges. Visually check for insulating-liquid leaks and rust spots.

D. Examine areas and space conditions for compliance with requirements for liquid-filled, medium-voltage transformers and other conditions affecting performance of the Work.

E. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will cross section barriers to reach load or line lugs.

F. Examine walls, floors, roofs, and concrete bases for suitable conditions for transformer installation.

G. Pre-Installation Checks:

1. Verify removal of any shipping bracing after placement.
2. Remove a sample of insulating liquid according to ASTM D923. Insulating-liquid values shall comply with NETA ATS, Table 100.4. Sample shall be tested for the following:

a. Dielectric Breakdown Voltage: ASTM D877 or ASTM D1816.
b. Acid Neutralization Number: ASTM D974.
c. Interfacial Tension: ASTM D971.
d. Color: ASTM D1500.
e. Visual Condition: ASTM D1524.

H. Verify that ground connections are in place and that requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at transformer location.

I. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

B. Transformer shall be installed level and plumb and shall tilt less than 1.5 degrees while energized.

C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. At Interior Locations: For grounding to grounding electrodes, use bare copper cable not smaller than No. 4/0 AWG. Bond surge arrester and neutrals directly to transformer enclosure and then to grounding electrode system with bare copper conductors. Keep leads as short as practicable, with no kinks or sharp bends. Make joints in grounding conductors and loops by exothermic weld or compression connector.
2. At Exterior Locations:

    a. For counterpoise, use tinned bare copper cable not smaller than No. 4/0 AWG, buried not less than 30 inches below grade interconnecting grounding electrodes. Bond surge arrester and neutrals directly to transformer enclosure and then to grounding electrode system with bare copper conductors. Keep lead lengths as short as practicable, with no kinks or sharp bends.
    b. Make joints in grounding conductors and loops by exothermic weld or compression connector.

3. Terminate all grounding and bonding conductors on a common equipment grounding terminal on transformer enclosure. Install supplemental terminal bars, lugs, and bonding jumpers as required to accommodate number of conductors for termination.
4. Complete transformer tank grounding and lightning arrester connections prior to making any other electrical connections.

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Maintain air clearances between energized live parts and between live parts and ground for exposed connections in accordance with manufacturer recommendations.
2. Bundle associated phase, neutral, and equipment grounding conductors together within transformer enclosure. Arrange conductors such that there is not excessive strain that could cause loose connections. Allow adequate slack for expansion and contraction of conductors.

C. Terminate medium-voltage cables in incoming section of substations according to Section 260513 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

A. Comply with installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

B. Install warning signs as required to comply with 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. General Field-Testing Requirements:

a. Comply with provisions of NFPA 70B, Ch. "Testing and Test Methods."
b. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
c. After installing transformer but before primary is energized, verify that grounding system at substation is tested at specified value or less.
d. After installing transformer and after electrical circuitry has been energized, test for compliance with requirements.
e. Visual and Mechanical Inspection:

1) Verify equipment nameplate data complies with Contract Documents.
2) Inspect bolted electrical connections for high resistance using one of the following two methods:

a) Use a low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In absence of manufacturer's published data, use NETA ATS, Table 100.12.

f. Remove and replace malfunctioning units and retest.
g. Prepare test and inspection reports. Record as-left set points of all adjustable devices.

2. Medium-Voltage Surge Arrester Field Tests:

a. Visual and Mechanical Inspection:

1) Inspect physical and mechanical condition.
2) Inspect anchorage, alignment, grounding, and clearances.
3) Verify arresters are clean.
4) Verify that ground lead on each device is individually attached to a ground bus or ground electrode.
5) Verify that stroke counter is correctly mounted and electrically connected if applicable. Record stroke counter reading.

b. Electrical Test:

1) Perform an insulation-resistance test on each arrester, phase terminal-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS,

Table 100.1. Replace units that fail to comply with recommended minimum insulation resistance listed in that table.

2) Perform a watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.

3. Liquid-Filled Transformer Field Tests:

a. Visual and Mechanical Inspection:

1) Test dew point of tank gases if applicable.
2) Inspect anchorage, alignment, and grounding.
3) Verify bushings are clean.
4) Verify that alarm, control, and trip settings on temperature and level indicators are set and operate within manufacturer's recommended settings.
5) Verify that cooling fans and pumps operate correctly and have appropriate overcurrent protection.
6) Verify that liquid level in tanks and bushings is within manufacturer's published tolerances.
7) Perform specific inspections and mechanical tests recommended by manufacturer.
8) Verify presence of transformer surge arresters and that their ratings are as specified.
9) Verify that as-left tap connections are as specified.
10) Verify presence of surge arresters and that their ratings are as specified.

b. Electrical Tests:

1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; the value of the index shall not be less than 1.0.
2) Perform power-factor or dissipation-factor tests on all windings according to test equipment manufacturer's published data. Maximum winding insulation power-factor/dissipation-factor values shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.3.
3) Measure core insulation resistance at 500-V dc if the core is insulated and the core ground strap is removable. Core insulation-resistance values shall not be less than 1 megohm at 500-V dc.

3.6 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each transformer. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than

1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during test period, is unacceptable.

2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:

    a. Adjust transformer taps.
    b. Prepare written request for voltage adjustment by electric utility.

3. Retests: Repeat monitoring, after corrective action is performed, until satisfactory results are obtained.
4. Report:

    a. Prepare a written report covering monitoring performed and corrective action taken.

B. Infrared Inspection: Perform survey during periods of maximum possible loading. Remove all necessary covers prior to inspection.

1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of transformer's electrical power connections.
2. Instrument: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 deg C at 30 deg C.
3. Record of Infrared Inspection: Prepare a certified report that identifies testing technician and equipment used, and lists results as follows:

    a. Description of equipment to be tested.
    b. Discrepancies.
    c. Temperature difference between area of concern and reference area.
    d. Probable cause of temperature difference.
    e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
    f. Identify load conditions at time of inspection.
    g. Provide photographs and thermograms of deficient area.

4. Act on inspection results according to recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

END OF SECTION 261213

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for **foundation and pads**.
3. Subbase course for concrete **foundations and pads**.
4. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
1. Section 311000 “Cast-In Place Concrete”

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Warning tapes.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each **borrow** soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to **ASTM D698**.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.5 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify the Alaska Dig Line at 800-478-3121 before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures required by the Alaska Department of Environmental Conservation are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification **Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487**, or a combination of these groups; free of rock or gravel larger than **3 inches** in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification **Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487**, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 6 percent passing a No. 200 sieve, in accordance with the State of Alaska DOT&PF Standard Specifications for Highways, Section 703-2.07 Selected Material, Type A.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 6 percent passing a No. 200 sieve in accordance with the State of Alaska DOT&PF Standard Specifications for Highways, Section 703-2.03 Aggregate Base Course, D1.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 6 percent passing a No. 200 sieve, in accordance with the State of Alaska DOT&PF Standard Specifications for Highways, Section 703-2.07 Selected Material, Type A.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 6 percent passing a No. 200 sieve.

H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

2.2 GEOTEXTILES

A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:
   a. Class 2; AASHTO M 288.
   b. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
   c. Permittivity: 0.02 per second, minimum; ASTM D4491.
   d. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives:

1. Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: **As indicated**.

C. Trench Bottoms:

1. Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for **changes in the Work**.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill voids with satisfactory soil while removing shoring and bracing.

D. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of **subbase material**, free of particles larger than **1 inch** in any dimension, to a height of 12 inches over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than **8 inches** in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to **ASTM D698**:

1. Under utility structures and foundation pads, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at **95** percent.

2. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at **90** percent.
3. For utility trenches, compact each layer of initial and final backfill soil material at **90** percent.

3.14 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus **1 inch**.

3.15 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course **and base course** on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course **and base course** under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place subbase course **and base course** 6 inches or less in compacted thickness in a single layer.
3. Place subbase course **and base course** that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact subbase course **and base course** at optimum moisture content to required grades, lines, cross sections, and thickness to not less than **95** percent of maximum dry unit weight according to **ASTM D698**.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
   1. Foundation Pad Backfill: At each compacted backfill layer, at least one test for every **1,000 square feet** or less but no fewer than two tests.
   2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every **150 feet** or less of trench length but no fewer than two tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000