DOCKETED	
Docket Number:	01-AFC-24C
Project Title:	Palomar Energy Project Compliance
TN #:	240085
Document Title:	Palomar Energy Center - Petition to Amend
Description:	Nitrogen Project
Filer:	Jason Dobbs
Organization:	San Diego Gas and Electric
Submitter Role:	Applicant
Submission Date:	10/15/2021 2:55:30 PM
Docketed Date:	10/15/2021

PETITION FOR NEW PROJECT APPROVAL TO INSTALL HRSG1&2 NITROGEN CONCENTRATOR SYSTEM AT THE PALOMAR ENERGY CENTER

(01-AFC-24C)

By:

SAN DIEGO GAS & ELECTRIC COMPANY
SAN DIEGO, CALIFORNIA

Submitted to:

CALIFORNIA ENERGY COMMISSION

October 15, 2021

PETITION FOR NEW PROJECT APPROVAL TO INSTALL A HRSG1&2 NITROGEN CONCENTRATOR SYSTEM AT THE PALOMAR ENERGY CENTER

(01-AFC-24C)

1.0 INTRODUCTION

San Diego Gas & Electric Company (SDG&E) is filing this petition for a proposed project design to install a HRSG1&2 Nitrogen Concentrator System at Palomar Energy Center (PEC), Docket (01-AFC-24C) pursuant to 20 Cal. Code Regs. Section 1769(a)(1). San Diego Gas & Electric (SDG&E or "the applicant") is proposing to install a Nitrogen Concentrator System at each Heat Recovery Steam Generator (HRSG) to provide Nitrogen for placing plant steam drums in a shutdown layup condition for maintenance and repair. This system would provide an reliable source of Nitrogen used for preventing HRSG internal corrosion during shutdown layup conditions and avoid the use of of portable Nitrogen cylinders. No changes in Conditions of Certification are necessary.

2.0 DESCRIPTION OF PROPOSED MODIFICATION (Sec. 1769(a)(1)(A))

Further details of the proposed facilities are as follows:

<u>Nitrogen Concentrator Installation</u>. SDG&E is proposing to add two Nitrogen Concentrator Systems (one on each HRSG). The installation will provide an unlimited source of Nitrogen gas required for placing plant steam drums in a layup condition required to prevent the introduction of oxygen into plant drum and piping systems to mitigate corrosion of susceptible metal components. Nitrogen is currently provided by gas bottles provided by local vendor. Location and arrangement drawings of the Nitrogen Concentrator System are attached in Appendix 1.

3.0 NECESSITY (Sec. 1769(a)(1)(B))

The installation of a Nitrogen Concentrator System will improve facility reliability, efficiency, and convenience.

4.0 TIMING (Sec. 1769(a)(1)(C) and (D))

SDG&E assumed ownership of the PEC about three years after issuance of the Final Decision and certification to Palomar Energy, LLC. Since taking ownership of the plant in 2006, SDG&E has continued to review the engineering and design of the plant in order to better serve the needs of SDG&E ratepayers. SDG&E has also benefited from experience gained operating the plant since assuming ownership. This "fine tuning" could not have taken place during the licensing proceeding because SDG&E was not the applicant, the plant was not yet operating, and Palomar Energy brought its own objectives to the development of the project for the merchant market. The addition of this expansion does not change or undermine the assumptions, rationale, findings, or other bases of the Final Decision. The change complies with all laws, ordinances, regulations and standards and does not have a significant environmental impact, as further described below.

5.0 ANALYSIS OF THE EFFECT OF THE MODIFICATIONS ON THE ENVIRONMENT (Sec. 1769(a)(1)(E))

The requested equipment change will have no significant effects on any of the technical areas analyzed in the August 2003 Final Commission Decision. Please see Table 1 below.

Table 1

Review of Effects of Installation and Operation of Nitrogen Concentrator System

TECHNICAL AREA	**SIGNIFICANT ENVIRONMENTAL IMPACT (Y/N)?**		**NOTES**
AIR QUALITY		N	no change
CULTURAL RESOURCES		N	Area for construction is prior filled area
EFFICIENCY		N	No impact
GEOLOGICAL HAZARDS		N	No change
HAZARDOUS MATERIALS HANDLING		N	No change
LAND USE		N	No change
NOISE		N	No Change
PALEONTOLOGICAL RESOURCES		N	Area for construction is prior filled area
BIOLOGICAL RESOURCES		N	Area previously disturbed.

TECHNICAL AREA	**SIGNIFICANT ENVIRONMENTAL IMPACT (Y/N)?**		**NOTES**
PUBLIC HEALTH		N	no change
RELIABILITY		N	No change
SOCIOECONOMICS		N	No change
SOILS		N	No change
TRAFFIC AND TRANSPORTATION		N	Construction traffic minimal
T-LINE SAFETY AND NUISANCE		N	No change
TRANSMISSION SYSTEM ENGINEERING		N	No change
VISUAL RESOURCES		N	No Change
WASTE MANAGEMENT		N	No change
WATER RESOURCES		N	No change
WORKER SAFETY		N	No change

6.0 COMPLIANCE WITH LAWS, ORDINANCES, REGULATIONS AND STANDARDS (LORS) (Sec. 1769(a)(1)(F))

The proposed improvements will not affect compliance with any other LORS requirement. Therefore, the proposed modification is not anticipated to impact SDG&E's ability to comply with the applicable LORS, as listed in Appendix A of the Commission Final Decision.

7.0 POTENTIAL EFFECTS ON PUBLIC AND NEARBY PROPERTY OWNERS (Sec. 1769(a)(1)(G and I))

The requested expansion will not have any environmental impacts and will comply with all applicable LORS. Thus, the proposed equipment change is not anticipated to affect nearby property owners or parties in the application proceedings or the public

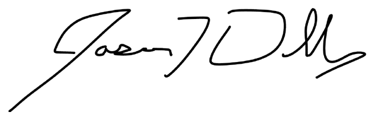
8.0 LIST OF PROPERTY OWNERS (Sec. 1769(a)(1)(H))

A list of property owners 1,000 feet of the plant site has previously been provided to the Commission CPM.

9.0 SUMMARY OF REQUEST

As demonstrated above, construction installation of a Nitrogen Concentrator System will not have an adverse effect on the public or the environment. The change will not affect compliance with applicable LORS. Accordingly, SDG&E requests that the Energy Commission Staff expedite review of this petition, and request Commission approval of the proposed modified conditions in accordance with Title 20 CCR Section 1769.

Respectfully Submitted,



Jason T. Dobbs
Generation Compliance Advisor

Dated: October 15, 2021

APPENDIX 1

PROJECT INFORMATION AND ARRANGEMENT DRAWING

LINE LEGEND	
(solid blue line)	DRY AIR IN
(dash-dot green line)	N2 PRODUCT TO TANK
(dashed dark green line)	N2 OUT TO PROCESS
(dashed red line)	GAS SAMPLE TO O2 ANALYZER

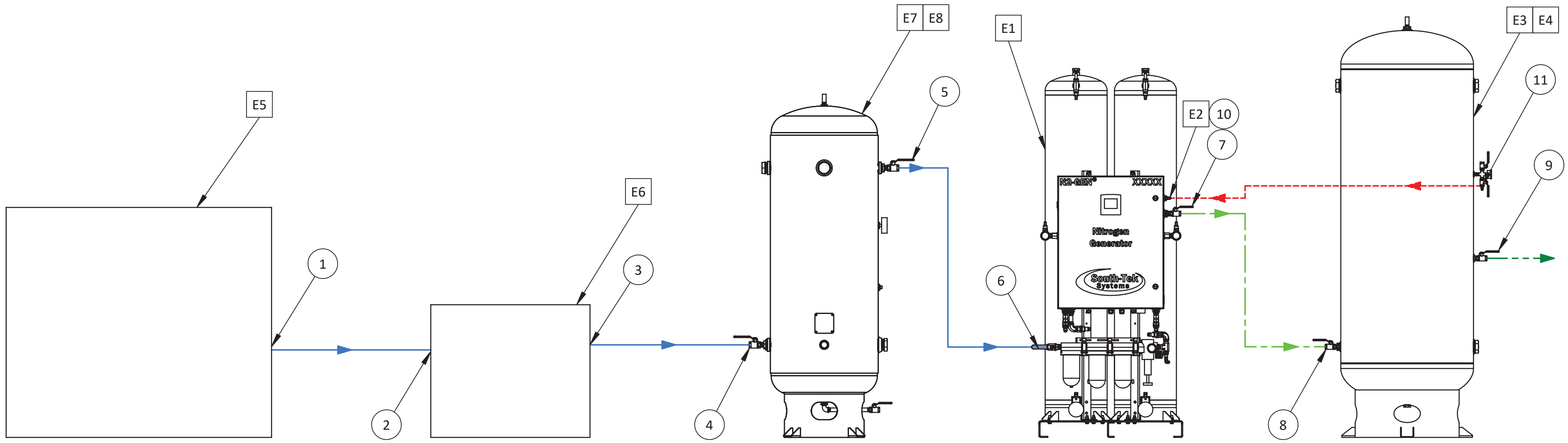
EQUIPMENT

ITEM #	STS #	DESCRIPTION
E1	N2-220CS-3P5	NITROGEN GENERATOR
E2	A02-MO2-CT-N4	MO2 ANALYZER ASSY FOR CS
E3	996887	400 GALLON NITROGEN STORAGE TANK
E4	A01-613-04-04-GLV	NITROGEN STORAGE TANK FITTINGS
E5	300345	ELGI 84 CFM 125PSI AIR COMPRESSOR
E6	997034	REFRIGERATED AIR DRYER
E7	105085	240 GALLON AIR RECIEVER TANK
E8	A01-604-08-08-A-GLV	AIR RECIEVER TANK FITTINGS

*Cabinet cooler is installed in the generator before shipping and uses 5 CFM of the Compressor's flow

FIELD CONNECTIONS

ITEM #	DESCRIPTION	SERVICE
1	1" NPT X OUTPUT	AIR
2	3/4" NPT X INPUT	AIR
3	3/4" NPT X OUTPUT	AIR
4	1" NPT X INPUT	AIR
5	1" NPT X OUTPUT	AIR
6	3/4" NPT X INPUT	AIR
7	1/2" X NPT OUTPUT	NITROGEN
8	1/2" X NPT INPUT	NITROGEN
9	1/2" X NPT OUTPUT	NITROGEN
10	1/4" OD PTC INPUT	SAMPLE
11	1/4" OD PTC OUTPUT	SAMPLE



DESIGN DATA

AIR FLOW	56 SCFM @ 110 PSI
N2 OUT FLOW	1246 SCFH @ 80 PSI
PURITY	99.500%
ELECTRICAL	110-240V / 50-60Hz / 1PHASE / < 2 AMPS

REV	TASK#	SHEET	DESCRIPTION	DATE	DRAWN	APPR.
-	-		-	-	-	-
-	-		-	-	-	-
00	-		RELEASE FOR CUSTOMER REVIEW	03/08/17	SDA	MRT

REVISIONS: ONLY THE LATEST 3 REVISIONS WILL BE SHOWN. OLDER REVISIONS CONSOLIDATED AND FILED.

South-Tek Systems

MATERIAL:

FINISH:

WEIGHT:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

ANGLES	X.	.X	.XX	.XXX	X/X<10'	X/X>10'
±.5°	±1	±.2	±.03	±.005	±1/16	±1/8

GENERAL ARRANGEMENT, SYSTEM FLOW AND CONNECTIONS

DRAWN:	APPROVED:
SDA	MRT
DATE: 03/24/17	DATE: 03/24/17

PROJECT NAME: KAAM GROUP INC

SIZE: B | SCALE: 1:24 | SHEET: 1 OF 1

NUMBER: GA - 220CS

REVISION: 00

PROJECT INFORMATION

PROJECT DATA

PROJECT DESCRIPTION:
ANCHORAGE OF (3) NEW PIECES OF EQUIPMENT AND (2) NEW STEEL TANKS TO EACH (E) HRSG MAT FOUNDATION (TOTAL OF 10 ITEMS TO BE ANCHORED).

APPLICANT/OWNER:
SEMPRA UTILITIES – PALOMAR ENERGY CENTER
2300 HARVESON PLACE, SD1473
ESCONDIDO, CA 92029

APPLICANT'S REPRESENTATIVE/ENGINEER:
MARTIN AND LIBBY
4452 GLACIER AVE
SAN DIEGO, CA 92120
TEL: (619) 280-9307
FAX: (619) 284-3533
CONTACT:
EMAIL:

ASSESSOR'S PARCEL NUMBER:
232-591-01-00

APPLICABLE CODES

WORK SHALL BE IN COMPLIANCE WITH THE FOLLOWING APPLICABLE CODES:

1. 2019 CALIFORNIA BUILDING CODE (CBC) BASED ON THE 2015 EDITION OF THE INTERNATIONAL BUILDING CODE (IBC).
2. 2019 CALIFORNIA MECHANICAL CODE BASED ON THE 2015 EDITION OF THE UNIFORM MECHANICAL CODE.
3. 2019 CALIFORNIA ELECTRICAL CODE BASED ON THE 2014 EDITION OF THE NATIONAL ELECTRICAL CODE.

CONSULTANTS

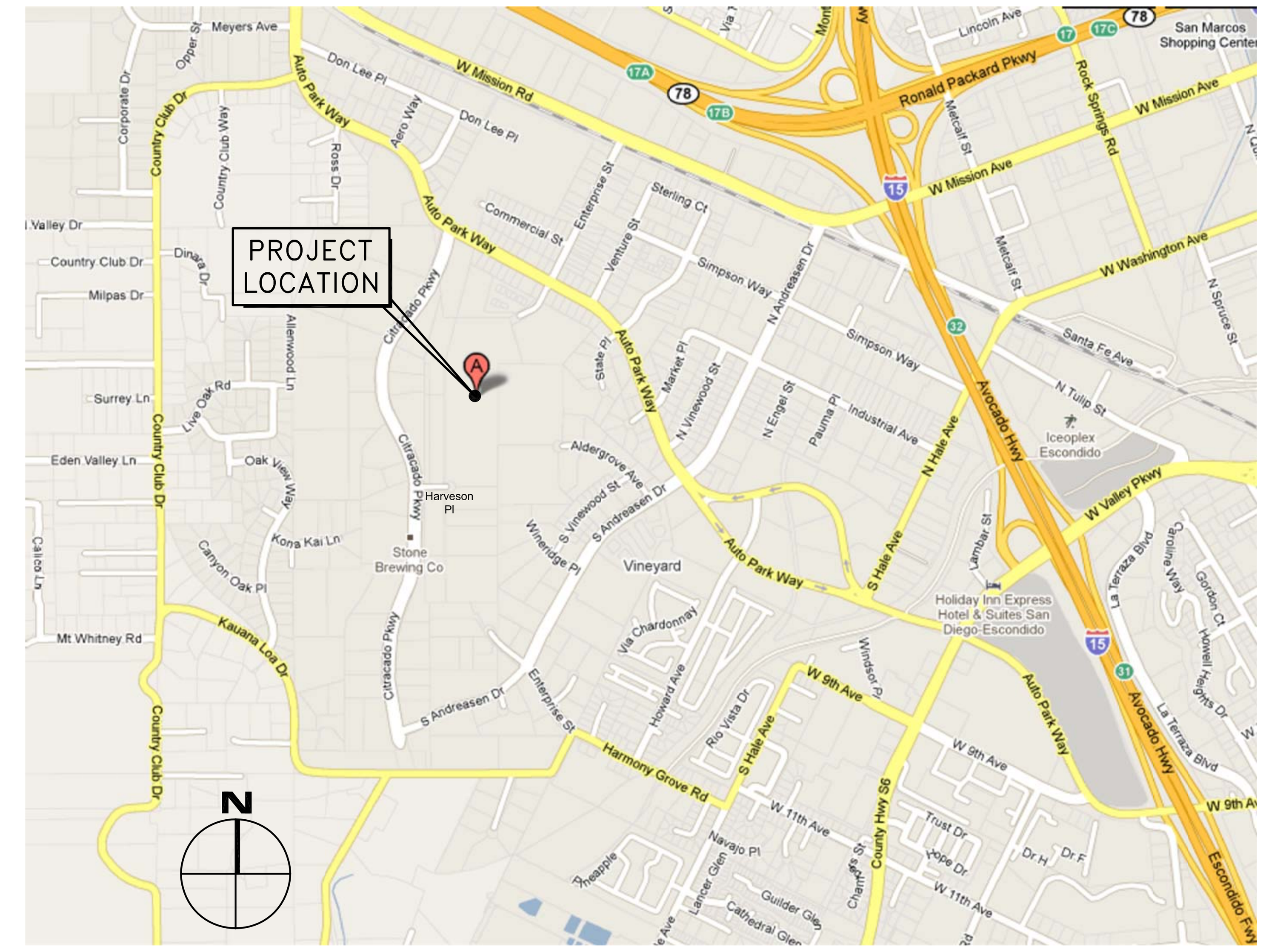
OWNER:
SEMPRA UTILITIES – PALOMAR ENERGY CENTER
2300 HARVESON PLACE, SD1473
ESCONDIDO, CA 92029

STRUCTURAL ENGINEER:
MARTIN AND LIBBY
4452 GLACIER AVE
SAN DIEGO, CA 92120
TEL: (619) 280-9307
FAX: (619) 284-3533
CONTACT:
EMAIL:

SHEET INDEX

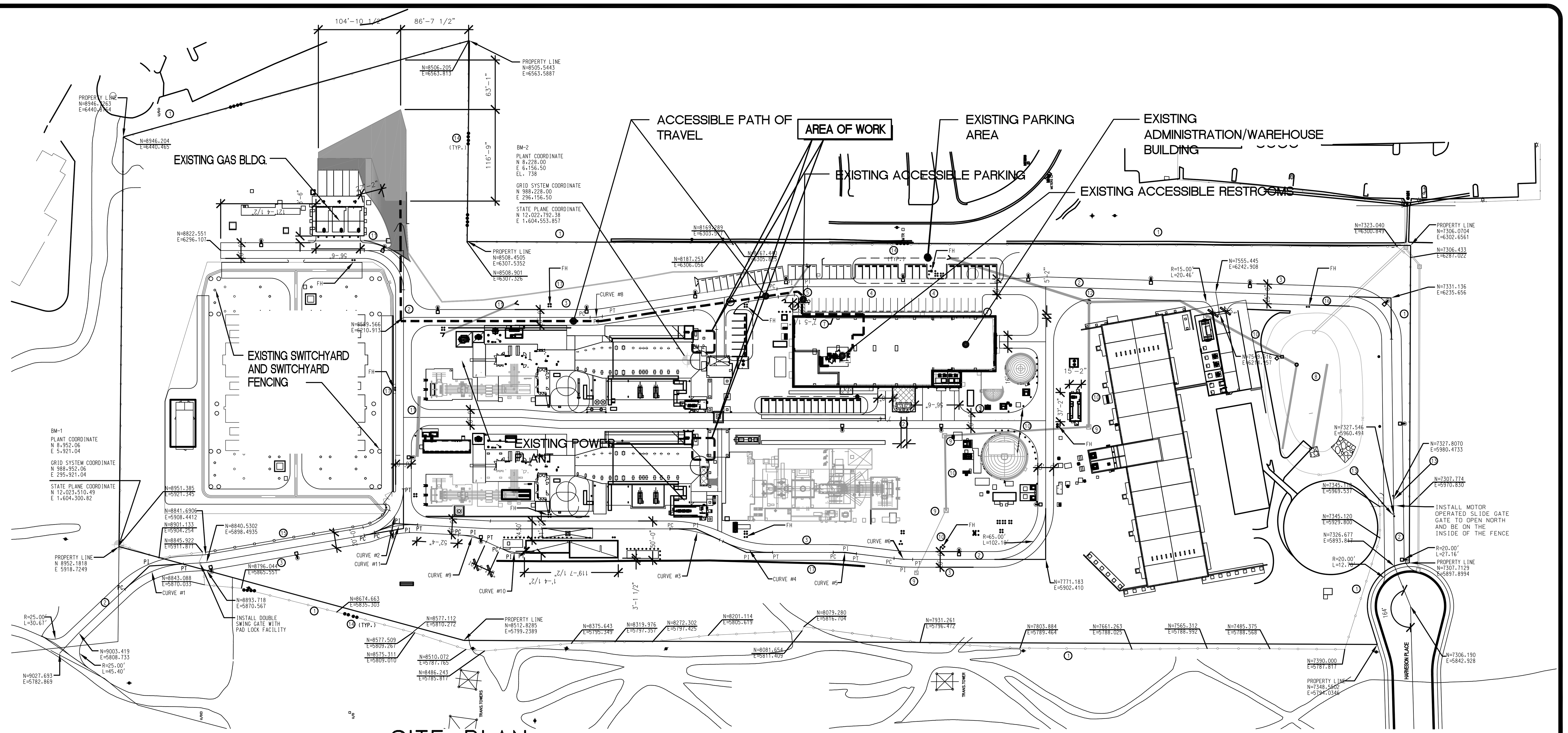
SHEET NUMBER	DESCRIPTION
	ARCHITECTURAL SITE DRAWINGS
T-1	TITLE SHEET
	STRUCTURAL DRAWINGS
S-1	GENERAL NOTES AND SPECIAL INSPECTION NOTES
S-2	PLAN
S-3	DETAILS

VICINITY MAP



VICINITY MAP

NOT TO SCALE



SITE PLAN

SCALE: 1" = 40'-0"

SITE SUMMARY

SITE GROSS AREA: 20.44 ACRES

ZONING: S-P SPECIAL DISTRICTS – VINEYARD/TIER 1

MAX. BUILDING HEIGHT ALLOWED: –

PROPOSED BUILDING HEIGHT:

SETBACKS

FRONT:	10'-0"
SIDE:	10'-0"
REAR:	15'-0"

SCOPE: CONSTRUCT (N) PRECAST SUMP PIT AT RETENTION POND

TYPE OF CONSTRUCTION: III-B

SPRINKLERS: N.A.

OCCUPANCY: F-1

OCCUPANCY LOAD: 2

NOT FOR CONSTRUCTION
THESE DRAWINGS HAVE BEEN PRINTED PRIOR TO ISSUANCE OF A BUILDING PERMIT AND ARE SUBJECT TO CHANGE.

REV	DATE	DESCRIPTION	BY
A	9/29/21	CLIENT REVIEW	

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 Glacier Avenue
San Diego, CA 92120
Ph (619) 280-9307
F (619) 284-3533
JOB NO 7396

TITLE SHEET

NITROGEN GENERATOR EQUIPMENT ANCHORAGE
PALOMAR ENERGY CENTER
ESCONDIDO, CA

REGISTERED PROFESSIONAL ENGINEER
DONALD ROLLA LIBBY
No. 2878
Exp. 12-31-22
STRUCTURAL
STATE OF CALIFORNIA
9/29/21

SCALE	AS NOTED
DRAWN	RBH
DESIGNED	JAS
CHECKED	DRL
JOB NO	7396
DATE	9/29/2021
SHEET NUMBER	T-1

10/14/21 * 12:12 pm * 7396 PEC NITROGEN ENERATOR EQUIPMENT.dwg

GENERAL

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS AND CONDITIONS AT THE JOB SITE BEFORE STARTING WORK, AND SHALL NOTIFY THE ENGINEER IMMEDIATELY OF ANY DISCREPANCIES.
2. ALL OMISSIONS OR CONFLICTS BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS AND SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE PROCEEDING WITH ANY WORK SO INVOLVED.
3. NOTES AND DETAILS ON THE DRAWINGS SHALL TAKE PRECEDENCE OVER THESE GENERAL NOTES AND TYPICAL DETAILS IN CASE OF CONFLICT.
4. IN NO CASE SHALL WORKING DIMENSIONS BE SCALED FROM PLANS, SECTIONS OR DETAILS ON THESE STRUCTURAL DRAWINGS.
5. ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH LOCAL STANDARDS AND THE APPLICABLE PROVISIONS OF THE 2019 CALIFORNIA BUILDING CODE (CBC) AS AMENDED BY THE CITY OF ESCONDIDO.
6. WHERE NO CONSTRUCTION DETAILS ARE SHOWN OR NOTED FOR ANY PART OF THE WORK, SUCH DETAILS SHALL BE THE SAME AS FOR SIMILAR WORK SHOWN ON THE DRAWINGS. MEMBER SIZES ARE GENERALLY FOUND ON PLANS. DETAILS AND SECTIONS GENERALLY REFER TO GENERIC ELEMENTS.
7. THE CONTRACT STRUCTURAL DRAWINGS AND SPECIFICATIONS REPRESENT THE FINISHED STRUCTURE, UNLESS OTHERWISE INDICATED. THEY DO NOT INDICATE THE METHOD OF CONSTRUCTION. THE CONTRACTOR SHALL PROVIDE ALL MEASURES NECESSARY TO PROTECT THE STRUCTURE, WORKMEN, AND OTHER PERSONS DURING CONSTRUCTION. SUCH MEASURES SHALL INCLUDE, BUT NOT BE LIMITED TO, BRACING, SHORING FOR CONSTRUCTION EQUIPMENT, SHORING FOR THE BUILDING, SHORING FOR EARTH BANKS, FORMS, SCAFFOLDING, PLANKING, SAFETY NETS, SUPPORT AND BRACING FOR CRANES AND GIN POLES, ETC. THE CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK AND HE OR SHE SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES AND PROCEDURES. OBSERVATION VISITS TO THE SITE BY THE ENGINEER SHALL NOT CONSTITUTE INSPECTION OF THE ABOVE ITEMS.
8. NOTIFY THE STRUCTURAL ENGINEER WHEN DRAWINGS BY OTHERS SHOW OPENINGS, POCKETS, ETC, NOT SHOWN ON THE STRUCTURAL DRAWINGS, BUT WHICH ARE LOCATED IN THE STRUCTURAL MEMBERS.
9. NO PIPES OR DUCTS SHALL BE PLACED IN FOUNDATION SLABS UNLESS SPECIFICALLY SHOWN OR NOTED ON THESE STRUCTURAL DRAWINGS. NO STRUCTURAL MEMBER SHALL BE CUT FOR PIPES, DUCTS, ETC, UNLESS SPECIFICALLY SHOWN.
10. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF DETAILS FOR AVOIDING THE INTERFERENCE OF MATERIALS TO BE EMBEDDED IN CONCRETE INCLUDING BUT NOT LIMITED TO REINFORCING STEEL, PRESTRESSING STEEL AND HARDWARE, MISCELLANEOUS STEEL AND CONDUITS. THIS IS BEST ACCOMPLISHED THROUGH CAREFUL COORDINATION OF SHOP DRAWINGS.
11. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING EXISTING UTILITIES IN THE WORK AREA AND SHALL REPAIR ANY DAMAGE CAUSED BY HIS OR HER OPERATIONS AT HIS OR HER OWN COST.
12. ALL SPECIFICATION AND CODES NOTED SHALL BE THE LATEST APPROVED EDITIONS AND REVISIONS BY THE GOVERNMENTAL AGENCY HAVING JURISDICTION OVER THIS PROJECT.

DESIGN CRITERIA

1. SEISMIC DESIGN DATA:

   RISK CATEGORY = III (CBC TABLE 1604.5)
   SEISMIC IMPORTANCE FACTOR = Ie =1.25 (ASCE 11.5.1)
   SITE CLASS = D (ASCE 20.3)
   MAPPED SPECTRAL RESPONSE ACCELERATION PARAMETERS (ASCE 11.4.2)
   $S_s = 0.889$
   $S_1 = 0.326$
   DESIGN SPECTRAL RESPONSE ACCELERATION PARAMETERS (ASCE 11.4.5)
   $S_{DS} = 0.711$
   S_{D1} = NULL (SEE ASCE 11.4.8)
   SITE COEFFICIENTS
   $F_a = 1.2$ (ASCE 11.4.4)
   F_v = NULL (SEE ASCE TABLE 11.4.8)
   SEISMIC DESIGN CATEGORY D (ASCE 11.6)

NONSTRUCTURAL COMPONENTS: (ASCE CH13)

MECHANICAL & ELECTRICAL COMPONENTS:
NAME OF COMPONENT: AIR COMPRESSOR, REFRIGERATED AIR DRYER, NITROGEN GENERATOR
COEFFICIENTS: (ASCE TABLE 13.6-1)
$a_p = 2.5$
$R_p = 6.0$
$\Omega_o = 2.0$
COMPONENT IMPORTANCE FACTOR $I_p = 1.25$
HORIZ DESIGN FORCE $F_p = 0.444W_p$ (ASCE 13.3.1)

DESIGN CRITERIA (CONTINUED)

NON-BUILDING STRUCTURES: (ASCE CH15)

NAME OF COMPONENT: AIR TANK, NITROGEN TANK
COEFFICIENTS: (ASCE TABLE 15.4-2)
$R_p = 2.0$
$\Omega_o = 2.0$
$C_d = 2.0$
IMPORTANCE FACTOR I = 1.25
HORIZ DESIGN FORCE $C_s = 0.444W$

CONCRETE

1. ALL CONCRETE SHALL BE NORMAL WEIGHT, 150 P.C.F. USE 1-INCH NOMINAL AGGREGATE WITH WATER/CEMENT RATIO NOT TO EXCEED 0.50.
2. CONCRETE STRENGTHS:

ITEM OF CONSTRUCTION	STRENGTH (P.S.I.)	SLUMP (INCHES) MAX
HOUSEKEEPING PAD	. . 3,000	4

3. CONCRETE PROTECTION FOR REINFORCEMENT. THE FOLLOWING MINIMUM CONCRETE COVER SHALL BE PROVIDED FOR REINFORCEMENT:

	MIN COVER (INCHES)
A. CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH:	3
B. CONCRETE EXPOSED TO EARTH OR WEATHER:	
NO 6 THROUGH NO 18 BAR	2
NO 5 BAR AND SMALLER	1 1/2
C. CONCRETE NOT EXPOSED TO WEATHER OR IN CONTACT WITH GROUND:	
SLABS, WALLS	
NO 14 AND NO 18 BAR	1 1/2
NO 11 BAR, AND SMALLER	3/4
BEAMS, COLUMNS PRIMARY REINFORCEMENT, TIES, STIRRUPS, SPIRALS	1 1/2

4. ANCHOR BOLTS AND DOWELS: SECURELY HELD IN PLACE PRIOR TO PLACING CONCRETE.
5. PIPES, DUCTS, VENTS AND SIMILAR OPENINGS ARE NOT PERMITTED UNLESS SHOWN ON THE STRUCTURAL DRAWINGS.
6. CHAMFER: 3/4" ON ALL EXPOSED CORNERS.
7. THE S.E.O.R. SHALL BE NOTIFIED 2 WORK DAYS IN ADVANCE OF ALL CONCRETE PLACEMENT.
8. FORMS FOR CONCRETE SHALL BE LAID OUT AND CONSTRUCTED TO PROVIDE THE SPECIFIED CAMBERS SHOWN ON THE DRAWINGS.
9. THE CONCRETE SLAB THICKNESS SHALL BE MAINTAINED UNLESS OTHERWISE SHOWN.
10. CEMENT SHALL BE ASTM C150 TYPE II OR TYPE V. USE TYPE V CEMENT AND CONCRETE COMPLYING WITH ACI 318 SECTION 19.3.2 WHEN CONCRETE IS EXPOSED TO SOILS CONTAINING SULFATES.
11. CONTRACTOR SHALL SUBMIT CONCRETE MIX DESIGNS TO THE S.E.O.R. FOR REVIEW PRIOR TO CASTING CONCRETE.
12. WHERE CONTINUOUS BARS ARE CALLED OUT, PROVIDE TIED CONTACT SPLICES AS REQUIRED. STAGGER SPLICES OF ALTERNATE BARS BY THE FULL SPLICE LENGTH.
13. CONCRETE MIXES MAY CONTAIN FLY ASH. THE FLY ASH SHALL CONFORM TO ASTM C618 CLASS F AND THE LOSS OF IGNITION SHALL BE LIMITED TO 2%. THE ADDITION RATE SHALL NOT EXCEED 15% OF THE CEMENT WEIGHT. THE CONTRACTOR SHALL SUBMIT ALL CERTIFICATES SHOWING THE FLY ASH CONFORMS TO THE ABOVE CRITERIA.
14. AGGREGATE FOR HARD ROCK CONCRETE SHALL CONFORM TO ALL REQUIREMENTS AND TESTS OF ASTM C33 AND PROJECT SPECIFICATIONS. EXCEPTIONS MAY BE USED ONLY WITH PERMISSION OF THE STRUCTURAL ENGINEER.
15. ALL CONSTRUCTION JOINTS SHALL BE RAISED TO MINIMUM 1/4" AMPLITUDE. ALL LAITANCE SHALL BE REMOVED PRIOR TO CASTING OVER THE CONSTRUCTION JOINT AND CONCRETE SURFACES SHALL BE MOISTENED TO A SATURATED SURFACE DRY CONDITION.
16. LOCATION OF ALL CONSTRUCTION, CONTROL, AND/OR WEAKENED PLANE JOINTS NOT SPECIFICALLY SHOWN ON THE DRAWINGS SHALL REVIEWED BY THE ENGINEER PRIOR TO PLACING REBAR.

REINFORCING STEEL

1. REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A615 GRADE 60.
2. ALL BARS SHALL BE DEFORMED BARS U.O.N.
3. VERTICAL REINFORCEMENT SHALL BE DOWELED TO THE SUPPORTING MEMBERS WITH THE SAME SIZE AND SPACING OF REINFORCEMENT AS CALLED FOR IN THE DRAWINGS OR STANDARD NOTES.
4. WELDING OF REINFORCEMENT IS NOT PERMITTED.

DRILLED IN ANCHORS AND BARS

1. ALL ANCHORS SHALL BE ICC APPROVED.
2. ALL ANCHORS SHALL BE INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURER'S APPROVED RESEARCH REPORT. SUBSTITUTIONS ARE REQUIRED TO BE REVIEWED BY THE ENGINEER AND HAVE AN APPROPRIATE ICC-ES REPORT.
3. DRILLED IN CONCRETE WEDGE ANCHORS SHALL BE:
   HILTI KWIK BOLT TZ2 . . . . ESR-4266
4. DRILLED IN ADHESIVE ANCHORS FOR CONCRETE SHALL BE:
   HILTI HIT-HY 200 . . . . ESR-3187
5. UNLESS OTHERWISE SHOWN, PROVIDE A MINIMUM OF 6xDIAMETER EDGE DISTANCES AND 12xDIAMETER SPACING OF ANCHORS.
6. FOR EXTERIOR USE DRILLED IN ANCHORS AND THREADED ROD ASSEMBLIES SHALL BE ASTM A304 STAINLESS STEEL.
7. DRILLED IN ANCHORS SHALL NOT BE INSTALLED IN CONCRETE OR MASONRY THAT HAS NOT REACHED THE SPECIFIED 28 DAY STRENGTH.
8. SPECIAL INSPECTION IN ACCORDANCE WITH CHAPTER 17 OF THE CBC MUST BE PROVIDED FOR ALL ANCHOR INSTALLATIONS. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, CONCRETE TYPE, CONCRETE COMPRESSIVE STRENGTH, HOLE DIMENSIONS, HOLE CLEANING PROCEDURES, ANCHOR SPACING, EDGE DISTANCES, CONCRETE THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. THE SPECIAL INSPECTOR MUST VERIFY THE INSTALLATIONS OF EACH TYPE AND SIZE OF ADHESIVE ANCHOR BY CONSTRUCTION PERSONNEL ON SITE.

ABBREVIATIONS

&	AND
@	AT
A.B.	ANCHOR BOLT
ABV	ABOVE
ADDL	ADDITIONAL
ALT	ALTERNATE
APPROX	APPROXIMATE
ART	ARTICLE
A.T.R.	ALL-THREAD-ROD
BLW	BELOW
BTM (B)	BOTTOM
BTWN	BETWEEN
CBC	CALIFORNIA BUILDING CODE
CH	CHAPTER
C.I.P.	CAST IN PLACE
C.J.	CONSTRUCTION JOINT
C.L. (℄)	CENTER LINE
CLR	CLEAR(ANCE)
CNTR	CENTER(ED)
COL	COLUMN
CONC	CONCRETE
CONN	CONNECT(ION)(OR)
CONST	CONSTRUCT(ION)
CONT	CONTINUOUS
C.Y.	CUBIC YARD(S)
DBL	DOUBLE
DEPT	DEPARTMENT
DIA (ø)	DIAMETER
DO	DITTO
DWG	DRAWING
DWL	DOWEL
EA	EACH
E.F.	EACH FACE
EL	ELEVATION
ELEC	ELECTRICAL
EMBED	EMBED(ED)(MENT)
EQ	EQUAL
EQUIP	EQUIPMENT
EXIST (E)	EXISTING
EXP	EXPANSION
EXT	EXTERIOR
FDN	FOUNDATION
FIN	FINISH(ED)
FLR	FLOOR
F.O.	FACE OF
F.O.C.	FACE OF CONCRETE
F.S.	FAR SIDE
FT	FOOT
FTG	FOOTING
F.V.	FIELD VERIFY
GA	GAUGE (GAGE)
GALV	GALVANIZE(D)
GRD	GRADE
H.D.G.	HOT DIPPED GALVANIZED
HORIZ (H)	HORIZONTAL
HT	HEIGHT
I.C.C.	INTERNATIONAL CODE COUNCIL
I.D.	INSIDE DIAMETER
IN	INCH(ES)
JT	JOINT
L	LONG (LENGTH)
LB	POUND
Ld	DEVELOPMENT LENGTH
LONGIT	LONGITUDINAL
MATL	MATERIAL
MAX	MAXIMUM
MEP	MECHANICAL/ ELECTRICAL/ PLUMBING
MFR	MANUFACTURER
MIN	MINIMUM
MISC	MISCELLANEOUS
MTL	METAL
(N)	NEW
N.I.C.	NOT IN CONTRACT
NO (#)	NUMBER
N.S.	NEAR SIDE
N.T.S.	NOT TO SCALE
O.C.	ON CENTER
O.D.	OUTSIDE DIAMETER
O.H.	OPPOSITE HAND
OPP	OPPOSITE

ABBREVIATIONS (CONTINUED)

PC	PIECE
P.C.F.	POUNDS PER CUBIC FOOT
P.L.F.	POUNDS PER LINEAR FOOT
P.S.F.	POUNDS PER SQUARE FOOT
P.S.I.	POUNDS PER SQUARE INCH
R	RADIUS
REF	REFERENCE
REINF	REINFORCE(ING) (MENT)
REQD	REQUIRED
SCHED	SCHEDULE(D)
SECT	SECTION
S.E.O.R.	STRUCTURAL ENGINEER OF RECORD
SHT	SHEET
SIM	SIMILAR
SPCG	SPACING
SPEC	SPECIFICATION
SQ	SQUARE
S.S.	STAINLESS STEEL
STD	STANDARD
STGR	STAGGER(ED)
STIFF	STIFFEN(ER)
STL	STEEL
STRUCT	STRUCTURAL
SYMM	SYMMETRICAL
T (T)	TOP
T&B	TOP & BOTTOM
THK	THICK(NESS)
THRD	THREAD(ED)
T.O.	TOP OF
T.O.C.	TOP OF CONCRETE
TOT	TOTAL
T.O.W.	TOP OF WALL
TRANS	TRANSVERSE
TYP	TYPICAL
ULT	ULTIMATE
U.O.N.	UNLESS OTHERWISE NOTED
VERT (V)	VERTICAL
W	WIDTH (WIDE)
W/	WITH
W/O	WITHOUT
WT	WEIGHT
YD	YARD

SPECIAL INSPECTIONS AND TESTS

1. THE SPECIAL INSPECTIONS AND TESTS LISTED ARE IN ADDITION TO THE CALLED INSPECTIONS AND TESTS REQUIRED BY CHAPTER 17 OF THE CBC, AS AMENDED. SPECIAL INSPECTION IS NOT A SUBSTITUTE FOR INSPECTION BY A CITY INSPECTOR.
2. CONTINUOUS INSPECTION IS ALWAYS REQUIRED DURING THE PERFORMANCE OF THE WORK UNLESS OTHERWISE SPECIFIED. WHEN WORK IN MORE THAN ONE CATEGORY OF WORK REQUIRING SPECIAL INSPECTION IS TO BE PERFORMED SIMULTANEOUSLY, OR THE GEOGRAPHIC LOCATION OF THE WORK IS SUCH THAT IT CANNOT BE CONTINUOUSLY OBSERVED IN ACCORDANCE WITH THE PROVISIONS OF CBC CHAPTER 17, IT IS THE AGENT'S RESPONSIBILITY TO EMPLOY A SUFFICIENT NUMBER OF INSPECTORS TO ASSURE THAT ALL THE WORK IS INSPECTED IN ACCORDANCE WITH THOSE PROVISIONS.
3. THE SPECIAL INSPECTORS MUST BE CERTIFIED BY THE CITY OF ESCONDIDO TO PERFORM THE TYPE OF INSPECTION SPECIFIED. EXCEPTIONS:
   A. SOILS INSPECTIONS BY THE SOILS ENGINEER OF RECORD.
   B. SMOKE CONTROL SYSTEM, BY THE MECHANICAL ENGINEER OF RECORD.
   C. WHEN WAIVED BY THE BUILDING OFFICIAL.
4. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY THE SPECIAL INSPECTOR OR INSPECTION AGENCY AT LEAST ONE WORKING DAY PRIOR TO PERFORMING ANY WORK THAT REQUIRES SPECIAL INSPECTION.
5. SPECIALLY INSPECTED WORK THAT IS INSTALLED OR COVERED WITHOUT THE APPROVAL OF THE CITY INSPECTOR IS SUBJECT TO REMOVAL OR EXPOSURE.
6. THE SPECIAL INSPECTOR SHALL SUBMIT IN WRITING A REPORT OF SPECIAL INSPECTIONS AND TESTS TO THE BUILDING OFFICIAL, OWNER, AND TO THE S.E.O.R.
7. THE INSPECTOR SHALL REPORT IN ADVANCE THEIR ASSIGNMENT TO THE CITY OF ESCONDIDO INSPECTION SERVICES DIVISION.
8. A CERTIFICATE OF SATISFACTORY COMPLETION OF WORK REQUIRING SPECIAL INSPECTION MUST BE COMPLETED AND SUBMITTED TO THE INSPECTION SERVICES DIVISION.
9. SPECIAL INSPECTOR SHALL BE HIRED BY THE OWNER (CBC SECTION 1704).
10. REQUIRED VERIFICATION, TESTING, QUALIFICATION AND/OR SPECIAL INSPECTION OF ELEMENTS AND NONSTRUCTURAL COMPONENTS OF BUILDINGS AND STRUCTURES SHALL BE IN ACCORDANCE WITH FOLLOWING:
    A. CONCRETE CONSTRUCTION: CBC SECTION 1705.3 AND TABLE 1705.3.
       1. MATERIAL TESTS: CBC SECTION 1705.3.2 AND ACI 318 CH 19 & 20.
       2. POST INSTALLED ANCHORS: TABLE 1705.3
          A. DRILLED IN ANCHORS
          B. ADHESIVE ANCHORS

REQUIRED VERIFICATION, SPECIAL INSPECTIONS AND TESTS OF CONCRETE CONSTRUCTION (CBC TABLE 1705.3)

VERIFICATION AND INSPECTION TASK	CONTINUOUS	PERIODIC	REFERENCED STANDARD[a]	IBC REFERENCE
1. INSPECT REINFORCEMENT, INCLUDING PRESTRESSING TENDONS, AND VERIFY PLACEMENT.	–	X	ACI 318 CH 20,25.2, 25.3, 26.6.1–26.6.3	1908.4
4. INSPECT ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS.[b] a. ADHESIVE ANCHORS INSTALLED IN HORIZONTALLY OR UPWARDLY INCLINED ORIENTATIONS TO RESIST SUSTAINED TENSION LOADS.	X		ACI 318: 17.8.2.4	–
b. MECHANICAL ANCHORS AND ADHESIVE ANCHORS NOT DEFINED IN 4.a.		X	ACI 318: 17.8.2	
5. VERIFYING USE OF REQUIRED DESIGN MIX.	–	X	ACI 318: CH 19, 26.4.3, 26.4.4	1904.1 1904.2 1908.2 1908.3
6. PRIOR TO CONCRETE PLACEMENT, FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE.	X	–	ASTM C172 ASTM C31 ACI 318: 26.5, 26.12	1908.10
8. VERIFY MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES.	–	X	ACI 318: 26.5.3–26.5.5	1908.9
	–	X	ACI 318: CH 26.9	–
12. INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED.	–	X	ACI 318: 26.11.1.2(b)	–

a. WHERE APPLICABLE, SEE ALSO SECTION 1705.12, SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE.
b. SPECIFIC REQUIREMENTS FOR SPECIAL INSPECTION SHALL BE INCLUDED IN THE RESEARCH REPORT FOR THE ANCHOR ISSUED BY AN APPROVED SOURCE IN ACCORDANCE WITH 17.8.2 IN ACI 318, OR OTHER QUALIFICATION PROCEDURES. WHERE SPECIFIC REQUIREMENTS ARE NOT PROVIDED, SPECIAL INSPECTION REQUIREMENTS SHALL BE SPECIFIED BY THE REGISTERED DESIGN PROFESSIONAL AND SHALL BE APPROVED BY THE BUILDING OFFICIAL PRIOR TO THE COMMENCEMENT OF THE WORK.

NOT FOR CONSTRUCTION
THESE DRAWINGS HAVE BEEN PRINTED PRIOR TO ISSUANCE OF A BUILDING PERMIT AND ARE SUBJECT TO CHANGE.

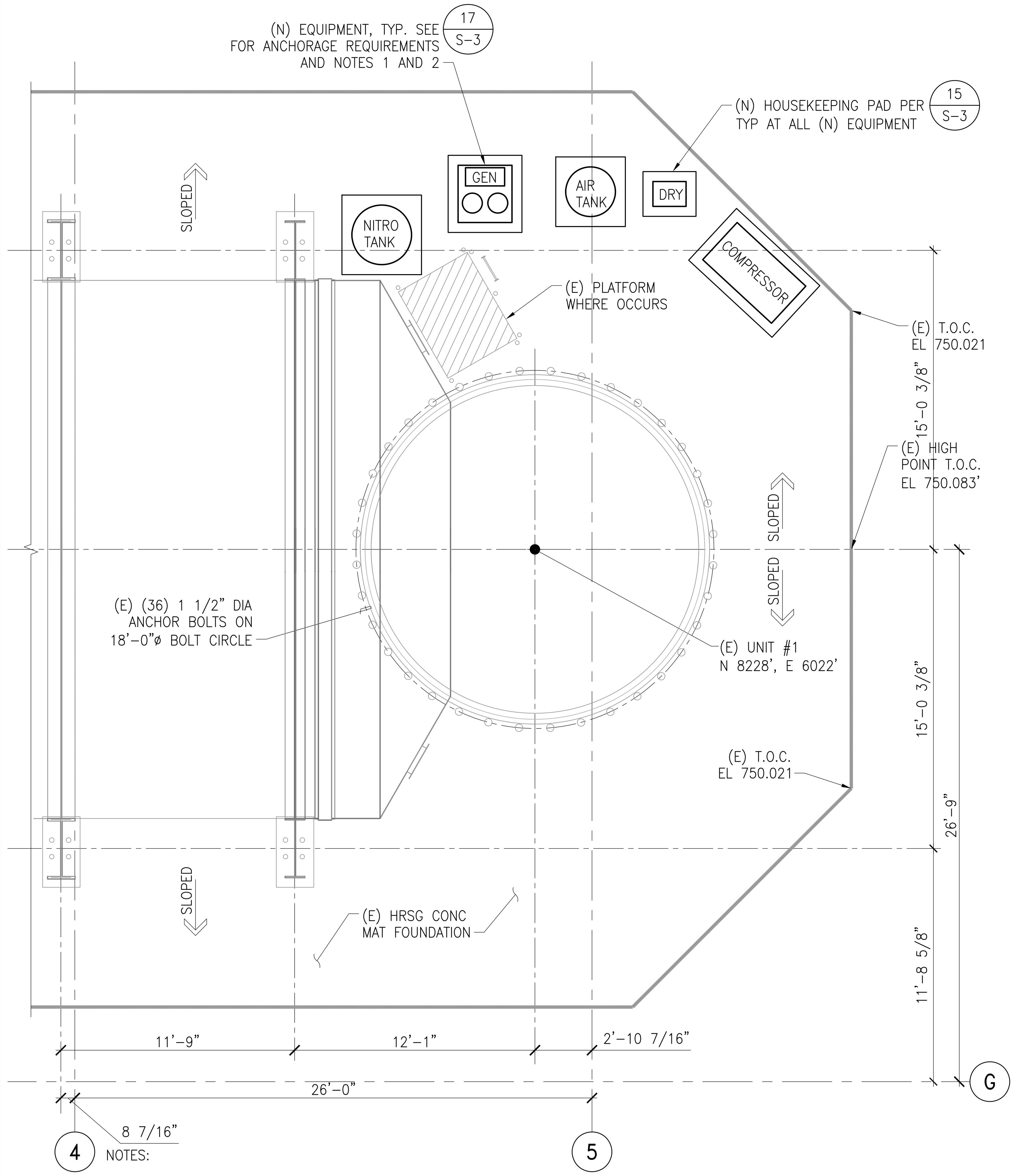
REV	DATE	DESCRIPTION	BY
A	9/29/21	CLIENT REVIEW	

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 Glacier Avenue
San Diego, CA 92120
Ph (619) 280-9307
F (619) 284-3533
JOB NO 7396

GENERAL NOTES AND SPECIAL INSPECTION NOTES
NITROGEN GENERATOR EQUIPMENT ANCHORAGE
PALOMAR ENERGY CENTER
ESCONDIDO, CA

REGISTERED PROFESSIONAL ENGINEER DONALD ROLLA LIBBY No. 2878 Exp. 12-31-22 STRUCTURAL STATE OF CALIFORNIA
9/29/21

SCALE AS NOTED
DRAWN RBH
DESIGNED JAS
CHECKED DRL
JOB NO 7396
DATE 9/29/2021
SHEET NUMBER
S-1



NOTES:

1) EQUIPMENT SHALL ONLY BE INSTALLED ON THE HRSG MAT FOUNDAITON AS SHOWN. EQUIPMENT LOCATIONS SHOWN ARE APPROXIMATE. CONTRACTOR SHALL COORDINATE FINAL LOCATIONS WITH OWNER IN THE FIELD. INSTALLATION SHALL CONFORM TO ANCHORAGE EDGE DISTANCE AND SPACING REQUIREMENTS PER 17/S-3 AND EQUIPMENT MANUFACTURER'S SPACING AND ARRANGEMENT RECOMMENDATIONS.

2) CONTRACTOR SHALL COORDINATE WITH THE OWNER EQUIPMENT CONNECTIONS TO EXISTING NITROGEN PIPES, ELECTRICAL POWER SUPPLY, AND ANY OTHER MEP CONNECTIONS REQUIRED FOR EQUIPMENT SYSTEM OPERATION.

PARTIAL FOUNDATION PLAN (1)

SCALE: 1/4" = 1'-0"

NOT FOR CONSTRUCTION

THESE DRAWINGS HAVE BEEN PRINTED PRIOR TO ISSUANCE OF A BUILDING PERMIT AND ARE SUBJECT TO CHANGE.

REV	DATE	DESCRIPTION	BY
A	9/29/21	CLIENT REVIEW	

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 Glacier Avenue
San Diego, CA 92120
Ph (619) 280-9307
F (619) 284-3533
JOB NO 7396

PLAN

NITROGEN GENERATOR EQUIPMENT ANCHORAGE

PALOMAR ENERGY CENTER

ESCONDIDO, CA

REGISTERED PROFESSIONAL ENGINEER DONALD ROLLA LIBBY No. 2876 Exp. 12-31-22 STRUCTURAL STATE OF CALIFORNIA 9/29/21

SCALE AS NOTED

DRAWN RBH

DESIGNED JAS

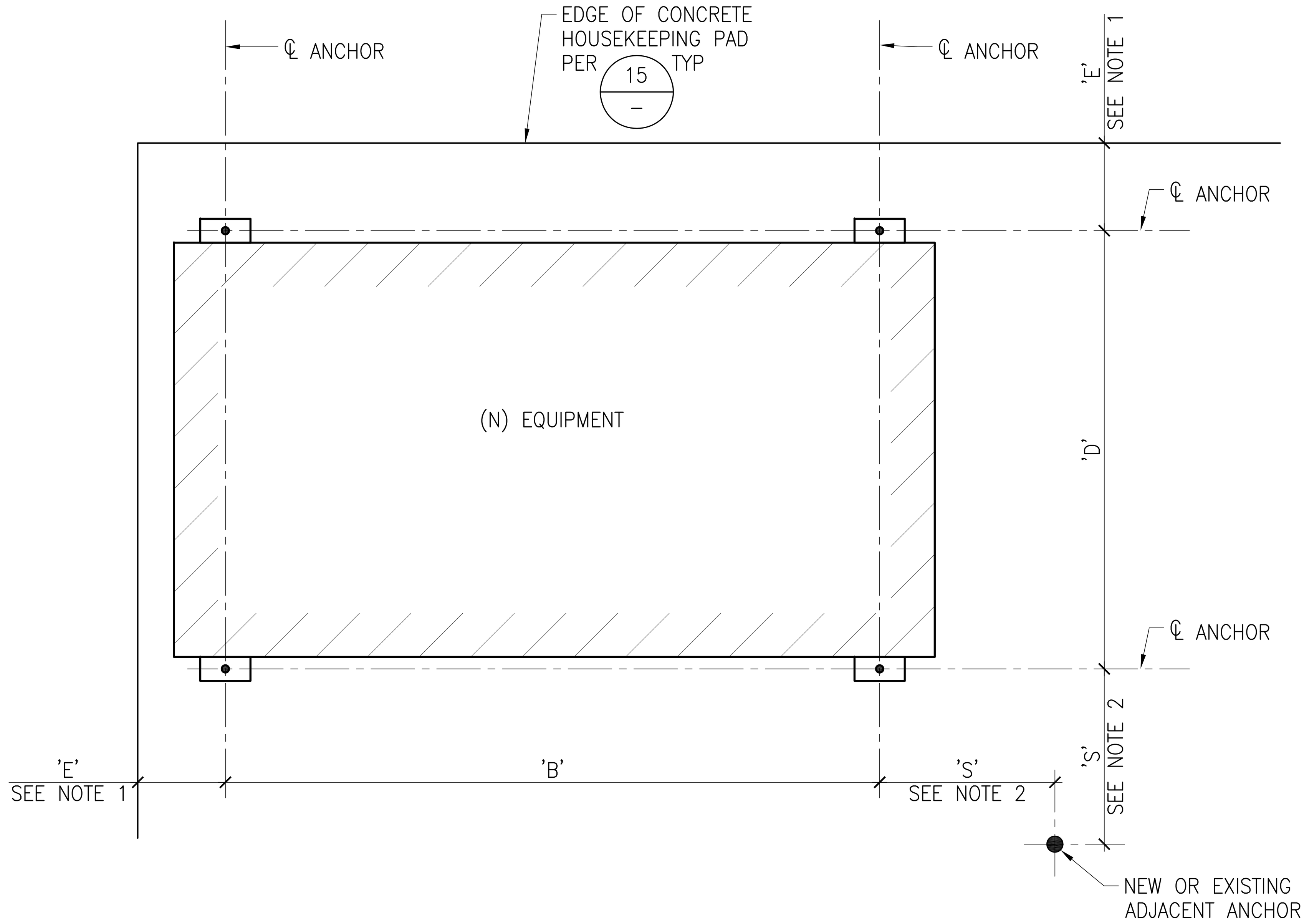
CHECKED DRL

JOB NO 7396

DATE 9/29/2021

SHEET NUMBER S-2

10/14/21 * 12:12 pm * 7396 PEC NITROGEN ENERATOR EQUIPMENT.dwg



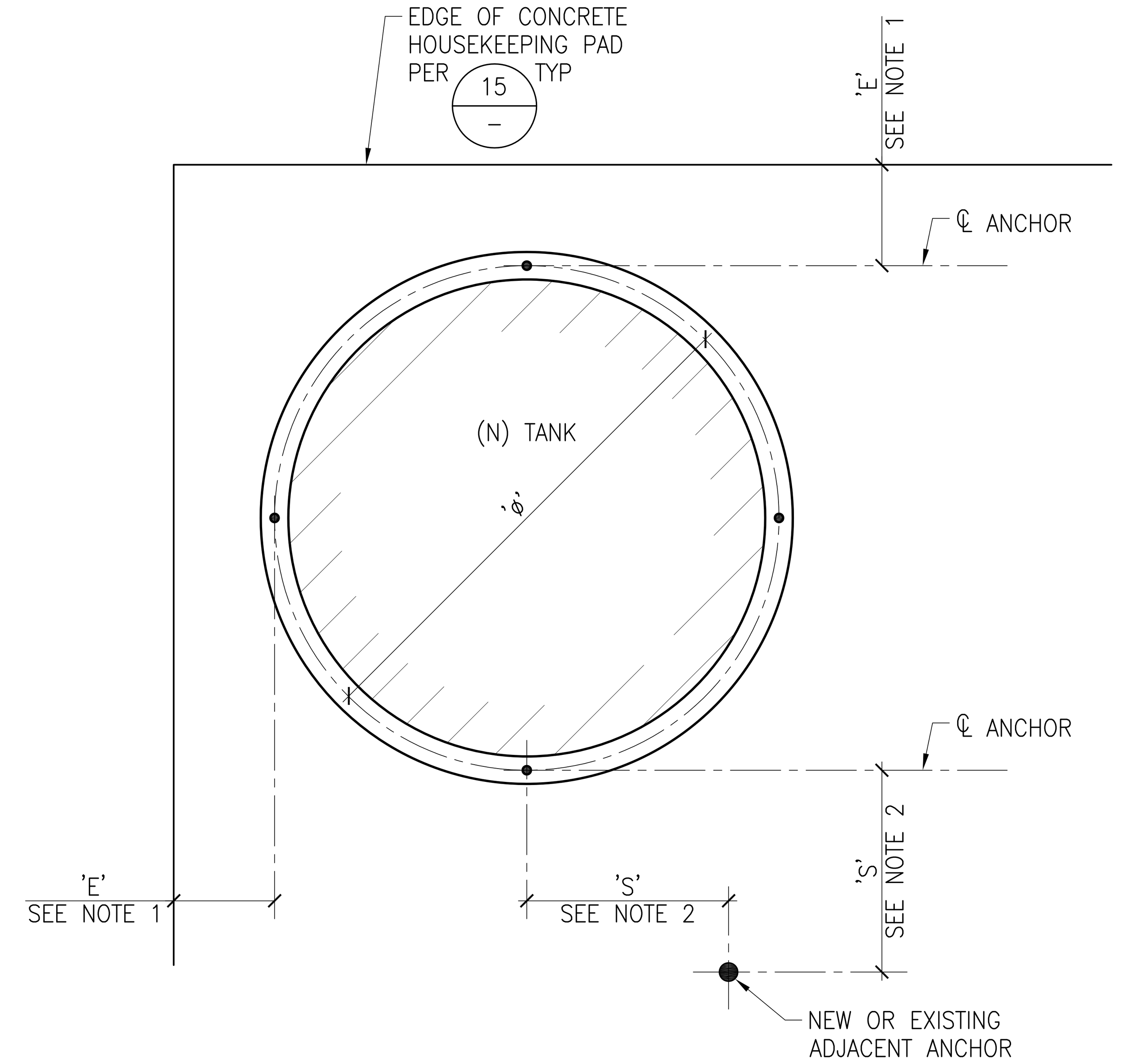
PLAN

NOTES:

1. INSTALLER SHALL MAINTAIN AT LEAST THE MINIMUM ANCHOR DISTANCE TO THE EDGE OF CONCRETE IN ALL DIRECTIONS.
2. INSTALLER SHALL MAINTAIN AT LEAST THE MINIMUM SPACING BETWEEN ADJACENT ANCHORS IN ALL DIRECTIONS.

EQUIPMENT ANCHORAGE (7)

SCALE: 1 1/2" = 1'-0"



PLAN

NOTES:

1. INSTALLER SHALL MAINTAIN AT LEAST THE MINIMUM ANCHOR DISTANCE TO THE EDGE OF CONCRETE IN ALL DIRECTIONS.
2. INSTALLER SHALL MAINTAIN AT LEAST THE MINIMUM SPACING BETWEEN ADJACENT ANCHORS IN ALL DIRECTIONS.

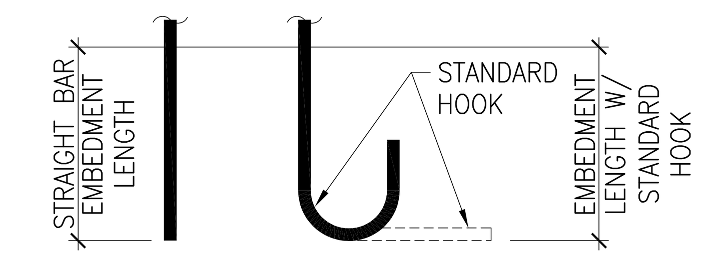
TANK ANCHORAGE (9)

SCALE: 1 1/2" = 1'-0"

REINFORCEMENT LAP SPLICE AND EMBEDMENT LENGTH

BAR SIZE	** MIN LAP LENGTH (IN)		** MIN EMBED LENGTH (IN)		
			STRAIGHT BARS		
	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS	W/STD HOOK
#3	28	22	22	17	9
#4	37	29	29	22	11
#5	47	36	36	28	14
#6	56	43	43	33	17
#7	81	63	63	48	20
#8	93	72	72	55	22
#9	105	81	81	62	25
#10	118	91	91	70	28
#11	131	101	101	78	31

fc = 3,000 P.S.I. Fy = 60,000 P.S.I.



** FOR BAR CLEAR SPACING LESS THAN 2 BAR DIAMETER, ADD 50%

NOTES:
1. MIN LAP ALL BARS CLASS 'B' UNLESS OTHERWISE NOTED.
2. STAGGER LAP OF HORIZONTAL WALL BARS.
3. TOP BARS ARE HORIZONTAL BARS W/MORE THAN 12" DEPTH OF CONCRETE CAST BELOW THE REINFORCEMENT. MULTIPLE HORIZONTAL BARS IN A SINGLE VERTICAL PLAN SUCH AS COLUMN TIES OR HORIZONTAL BARS IN WALLS ARE NOT TOP BARS.

REBAR SPLICE (CLASS B) & EMBEDMENT f'c = 3000 P.S.I. (10)

SCALE: NONE

EQUIPMENT ANCHORAGE SCHEDULE

EQUIPMENT		ANCHOR LAYOUT			ANCHORS(2)	'E' MINIMUM EDGE DISTANCE	'S' MINIMUM ANCHOR SPACING	DETAILS
TYPE	WEIGHT	'B'	'D'	'ø'				
AIR COMPRESSOR	1345 LB	44.8"	30"	N/A	(4) 1/2"ø HILTI KB-TZ2 A304 S.S. EMB = 3 1/4" MIN	6"	12"	7 / –
REFRIGERATED(1) AIR DRYER	92 LB	14"	12"	N/A	(4) 1/4"ø HILTI KB-TZ2 A304 S.S. EMB = 1 1/2" MIN	6"	12"	7 / –
240 GAL AIR TANK	542 LB	N/A	N/A	26 7/16"	(4) 5/8"ø HILTI KB-TZ2 A304 S.S. EMB = 3 1/4" MIN	6"	12"	9 / –
NITROGEN GENERATOR	1600 LB	30"	33"	N/A	(4) 3/8"ø HILTI KB-TZ2 A304 S.S. EMB = 2 1/2" MIN	6"	12"	7 / –
400 GAL NITROGEN TANK	3437 LB	N/A	N/A	32 7/16"	(4) 5/8" HILTI HAS-R A304 S.S. THREADED ROD EMB = 8" MIN W/HILTI HIT-HY 200 EPOXY (SEE NOTE 3)	8"	16"	9 / –

FOOTNOTES:

(1) MANUFACTURER'S INFORMATION DOES NOT SPECIFY ANCHOR LAYOUT DIMENSIONS OR ANCHOR HOLE DIAMETER. ANCHOR SPECIFIED ABOVE IS MINIMUM REQUIRED; HOWEVER INSTALLER SHALL FIELD MEASURE ANCHOR HOLE DIAMETER AND INSTALL ANCHOR 1/16" TO 1/8" LESS THAN HOLE DIAMETER MEASURED.
(2) ANCHORS SHALL BE EMBEDDED/INSTALLED INTO HOUSEKEEPING PAD UNLESS OTHERWISE NOTED.
(3) ANCHOR SHALL EXTEND THROUGH HOUSEKEEPING PAD AND EMBEDMENT SHALL BEGIN AT TOP OF EXISTING FOUNDATION

EQUIPMENT ANCHORAGE SCHEDULE (17)

SCALE: NONE

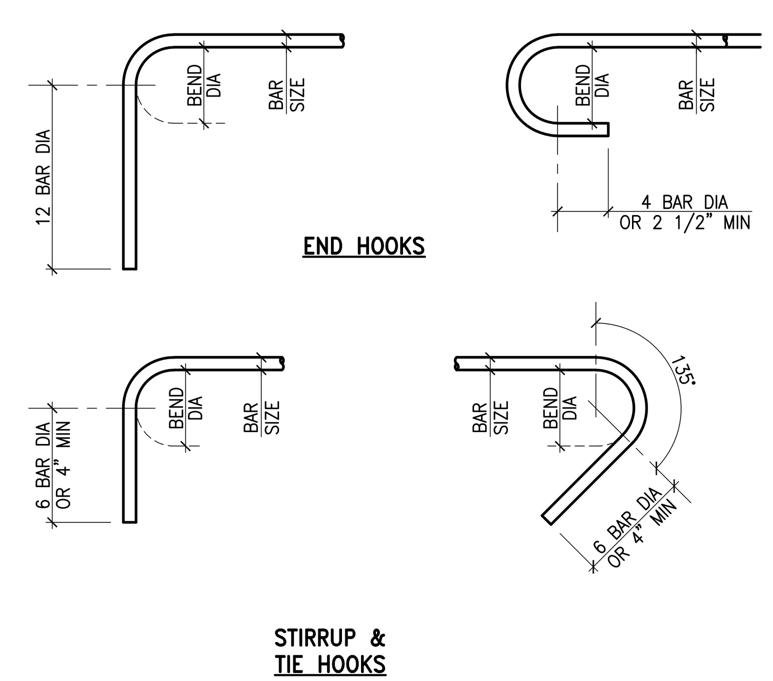
TABLE 1 – PRIMARY REINFORCEMENT

BAR BEND	BAR SIZE	MIN BEND DIA*
ALL GRADES OF REINFORCEMENT	#3 THRU #8	6 BAR DIA
	#9, #10 & #11	8 BAR DIA
	#14 & #18	10 BAR DIA

TABLE 2 – STIRRUP & TIE REINFORCEMENT

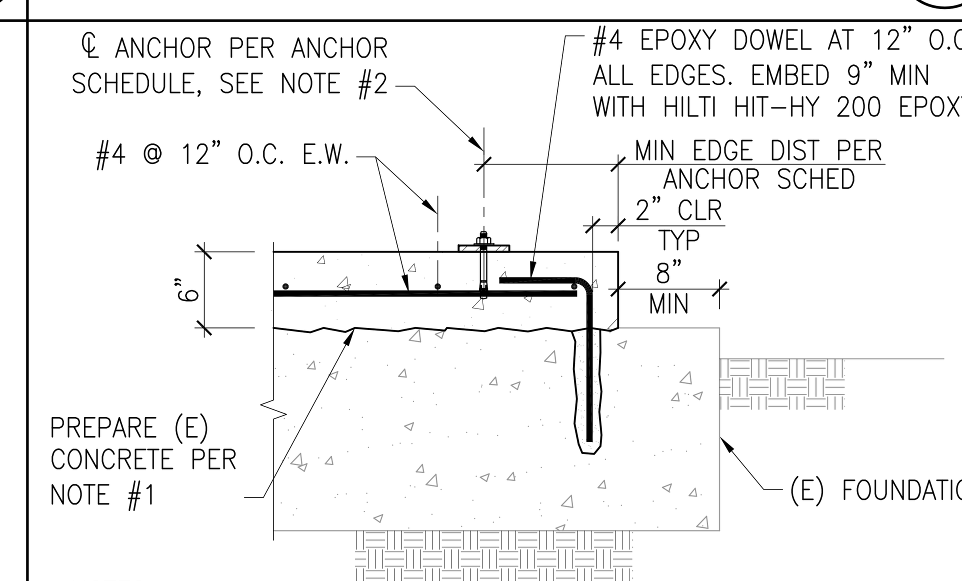
BAR SIZE	MIN BEND DIA*
#3 THRU #5	4 BAR DIA
ALL OTHER BARS	SEE TABLE 1

NOTES:
* MEASURED ON INSIDE OF BAR.
1. ALL REINFORCEMENT BENT COLD.
2. FIELD BENDING NOT PERMITTED U.O.N.



REINFORCEMENT HOOKS (14)

SCALE: NONE



NOTES:
1. ROUGHEN EXISTING SURFACE TO A MINIMUM 1/4" AMPLITUDE. REMOVE ALL LAITANCE AND MOISTENED EXISTING SURFACES TO A SATURATED SURFACE DRY CONDITION PRIOR TO PLACING NEW CONCRETE
2. REFER TO ANCHOR SCHEDULE FOR CONDITIONS WERE ANCHOR EMBEDMENT BEGINS AT TOP OF (E) FOUNDATION.

TYPICAL HOUSEKEEPING PAD (15)

SCALE: 1" = 1'-0"

NOT FOR CONSTRUCTION
THESE DRAWINGS HAVE BEEN PRINTED PRIOR TO ISSUANCE OF A BUILDING PERMIT AND ARE SUBJECT TO CHANGE.

REV	DATE	DESCRIPTION	BY
A	9/29/21	CLIENT REVIEW	

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 Glacier Avenue
San Diego, CA 92120
Ph (619) 280-9307
F (619) 284-3533
JOB NO 7396

DETAILS

NITROGEN GENERATOR EQUIPMENT ANCHORAGE
PALOMAR ENERGY CENTER
ESCONDIDO, CA

REGISTERED PROFESSIONAL ENGINEER DONALD ROLLA LIBBY No. 2878 Exp. 12-31-22 STRUCTURAL STATE OF CALIFORNIA
9/29/21

SCALE AS NOTED
DRAWN RBH
DESIGNED JAS
CHECKED DRL
JOB NO 7396
DATE 9/29/2021
SHEET NUMBER
S-3

10/14/21 * 12:27 pm * 7396 PEC NITROGEN ENERATOR EQUIPMENT.dwg

STRUCTURAL CALCULATIONS

FOR

PALOMAR ENERGY CENTER
NITROGEN EQUIPMENT ANCHORAGE

M&L Job No.: 7396
Date: October 14, 2021

MARTIN & LIBBY
Structural Engineers
4452 Glacier Avenue
San Diego, CA 92120-3304
Phone: (619) 280-9307
Fax : (619) 284-3533

REGISTERED PROFESSIONAL ENGINEER
DONALD ROLLA LIBBY
No. 2878
Exp. 12-31-22
STRUCTURAL
STATE OF CALIFORNIA

Table of Contents

PROJECT DESCRIPTION

The following structural calculations are for the anchorage of the following equipment for the existing HRSG mat foundation.

	Equipment	Weight
1)	EG15-215 Air Compressor	Wt. = 1345 lbs
2)	Refrigerated Air Dryer – South-Tek Systems Model 003-196	Wt. = 92 lbs
3)	240 Gallon Air Receiver Tank	Wt. = 542 lbs
4)	N2 Gen 220CS-3P5 PSA Nitrogen Generator	Wt. = 1600 lbs
5)	400 Gallon Nitrogen Storage Tank	Wt. = 717 lbs[(1)]

(1) Weight on tank only, does not include contents

Based on the weights and seismic forces of the equipment it has been assumed that the foundation supporting the HRSG is adequate.

Design Criteria – Seismic

Site Parameters

Address: 2300 Harveson Place, Escondido, CA 92029
Latitude: 33.119607
Longitude: -117.117415
Site Class: D - Default
Ss: 0.889
S1: 0.326
SMs: 1.067
SM1: null
SDs: 0.711
SD1: null

Risk Category: III
Importance Factor, Ie = 1.25
Seismic Design Category: D

Compressor Unit, Refrigerated Air Dryer, and Nitrogen Generator

- Determine anchor design forces per ASCE 7-16 Chapter 13 for Nonstructural Components

Seismic Design Parameters per ASCE 7-16 Chapter 13 Table 13.6-1

$$Fp = \frac{0.4a_pS_{DS}W_p}{\frac{R_p}{I_p}}\left(1+2(\frac{z}{h})\right); where\ \frac{z}{h} = 1.0$$

$$Fp,\min = 0.3S_{DS}\,I_pW_p = 0.267W_p$$
$$Fp,\max = 1.6S_{DS}I_pW_p = 1.422W_p$$

Equipment	a_p	R_p	Ω_p	F_p
EG15-215 Air Compressor	1.0	2.5	2	0.427
Refrigerated Air Dryer – South-Tek Systems Model 003-196	2.5	6	2	0.444
N2 Gen 220CS-3P5 PSA Nitrogen Generator	1	2.5	2	0.427

$$\therefore Fp = 0.444W_p Governs$$

Design Criteria – Seismic Continued

- Provide envelope design based on seismic parameters provided in Chapter 15 Table 15.4-2 and guidance for rigid non-building structures provided in Section 15.4.2. Design anchorage for more conservative loading.

Seismic Design Parameters per ASCE 7-16 Chapter 15 Table 15.4-2

Equipment	R	Ω_o	C_d	V
240 Gallon Air Tank	2	2	2	0.444
400 Gallon Nitrogen Tank	2	2	2	0.444

$$C_s = \frac{S_{DS}}{\frac{R}{I}} = \frac{0.711}{\frac{2.0}{1.25}} = 0.444$$

$$(C_S)\min = 0.044 S_{DS} I = 0.039$$

Seismic Design Parameters per ASCE 7-16 Chapter 15 Section 15.4.2

$$V_{Rigid} = 0.3 S_{DS} I_p W_p = 0.3(0.711)(1.25)W_p = 0.267 W_p$$

$$\therefore C_s = 0.444\ GOVERNS$$

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 Glacier Ave.
San Diego, CA 92120

Computed By: ________ Date: ________ Checked By: ________ Date ________ Sheet No. ____ Of ____

Project No. ________ Note No. ________ Subject ________________

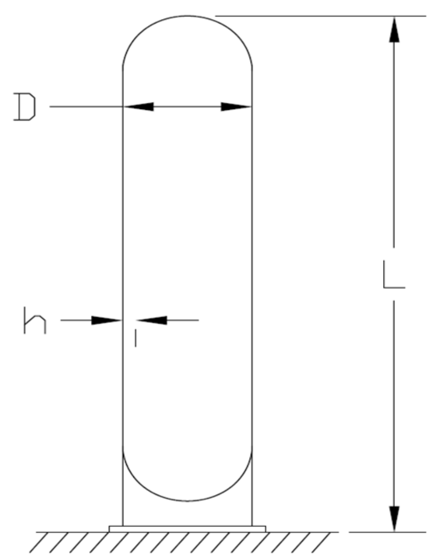
Vessel Fundamental Period of Vibration Calculation

Explanation of Calculation

The fundamental period of vibration calculated below was done following guidelines found in ASME technical article, “Vibrations of Vertical Pressure Vessels” by Freese. Procedure follows mechanical vibrations design methodology, assuming a uniformly loaded cantilever beam with section properties and stiffness specific to the vessel in question.

Height of vessel used in calculation includes the tank, cap, and skirt. The height due to threaded lug and davit at top of tank was excluded as it is an auxiliary component that should not be included in the calculation of the tank’s stiffness and/or spring constant. The period of vibration was calculated using operating weight of tank as this is the weight that ASCE7-05 prescribes to be used in calculation of the lateral force, V.

Vessel: Air Tank



Vessel Parameters

Height, L =	7.67	[ft]
Diameter, D =	2.5	[ft]
Thickness, h =	0.0208	[ft] (Assume 1/4" Thick Walls)
Weigth, (Wt)Dry =	542	[lbs]
Weigth, (Wt)Operating =	542	[lbs]
Weigth, (Wt) Flooded =	542	[lbs]

Fundamental Period, $T = 7.46\text{x}10^{-6} \text{ x } \left(\frac{L}{D}\right)^2 \text{ x } \left(\frac{W x D}{h}\right)^{(1/2)}$

Note: W in equation is distributed force in #/ft

(T)Dry =	0.0065	[s]
(T)Operating =	0.0065	[s]
(T)Flooded =	0.0065	[s]
(f)Dry =	154.5291	[Hz]
(f)Operating =	154.5291	[Hz]
(f)Flooded =	154.5291	[Hz]

$$\text{Frequency (f)} = \frac{1}{\text{Period}} \text{ (T)}$$

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 GLACIER AVE.
SAN DIEGO, CA 92120

Computed By: ________ Date: ________ Checked By: ________ Date ________ Sheet No. ____ Of ____

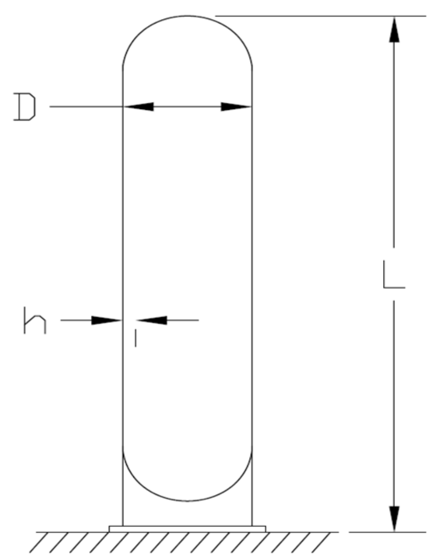
Project No. ________ Note No. ________ Subject ________________

Vessel Fundamental Period of Vibration Calculation

Explanation of Calculation

The fundamental period of vibration calculated below was done following guidelines found in ASME technical article, "Vibrations of Vertical Pressure Vessels" by Freese. Procedure follows mechanical vibrations design methodology, assuming a uniformly loaded cantilever beam with section properties and stiffness specific to the vessel in question.
Height of vessel used in calculation includes the tank, cap, and skirt. The height due to threaded lug and davit at top of tank was excluded as it is an auxiliary component that should not be included in the calculation of the tank's stiffness and/or spring constant. The period of vibration was calculated using operating weight of tank as this is the weight that ASCE7-05 prescribes to be used in calculation of the lateral force, V.

Vessel: Nitrogen Tank



Vessel Parameters

Height, L =	8.79	[ft]
Diameter, D =	3	[ft]
Thickness, h =	0.0208	[ft] (Assume 1/4" Thick Walls)
Weigth, (Wt)Dry =	717	[lbs]
Weigth, (Wt)Operating =	3437	[lbs]
Weigth, (Wt) Flooded =	3437	[lbs]

Fundamental Period, $T = 7.46x10^{-6} \text{ x } \left(\frac{L}{D}\right)^2 \text{ x } \left(\frac{W x D}{h}\right)^{(1/2)}$

Note: W in equation is distributed force in #/ft

(T)Dry =	0.0069	[s]
(T)Operating =	0.0152	[s]
(T)Flooded =	0.0152	[s]
(f)Dry =	143.9567	[Hz]
(f)Operating =	65.7509	[Hz]
(f)Flooded =	65.7509	[Hz]

Frequency (f) = $\frac{1}{\text{Period}}$ (T)

Computed By : **JAS**	Date: **10/14/2021**	Checked By :	Date:	Sheet No 4
Project No. 7396	Note No.	Subject: PEC N2 Gen Set		

Air Compressor Anchorage Forces

- See attached spreadsheet for anchor force calculation.
- Loads provided are factored using LFRD load combinations.

$$T = \frac{471\ lbs}{2\ Anchors} = 236 \frac{lbs}{Anchor} MAX$$

$$P_D = \frac{452\ lbs}{2\ Anchors} = 226 \frac{lbs}{Anchor} MIN$$

$$T_{net} = 236 - 226 = 10\ lbs\ Uplift$$

$$T_\Omega = \frac{941\ lbs}{2\ Anchors} = 471 \frac{lbs}{Anchor} MAX$$

$$P_D = \frac{452\ lbs}{2\ Anchors} = 226 \frac{lbs}{Anchor} MIN$$

$$T_{\Omega\ NET} = 471 - 226 = 245\ lbs\ Uplift$$

$$V_\Omega = \frac{1195\ lbs}{2\ anchors\ min} = 598\ lbs$$

Use 1/2" diameter x 3.25” Embed Hilti KB-TZ2 A304 SS. Maintain 6” edge distance and anchor spacing all sides

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 GLACIER AVE.
SAN DIEGO, CA 92120

Computed By: ________ Date: ________ Checked By: ________ Date ________ Sheet No. ____ Of ____

Project No. ________ Note No. ________ Subject ________________

Anchorage Force Calculation

Equipment: Air Compressor

Equipment Parameters

Height, H =	58.04	[in]
CL Anchor Width, B =	44.8	[in]
CL Anchor Depth, D =	30	[in]
Center of Gravity, X =	22.35	[in]
Center of Gravity, Y =	23.62	[in] (Veritcal)
Center of Gravity, Z =	13.31	[in]
Operating Weigth, W =	1345	[lbs]
SDS =	0.711	
Base Shear Coeff. =	0.444	
SDS =	0.711	
Ωo =	2	

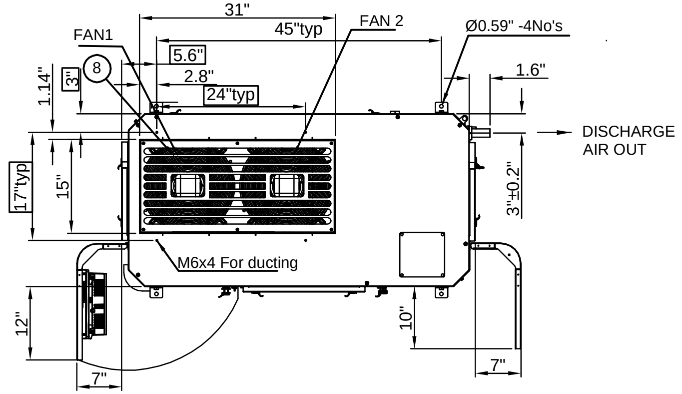
Load Combinations

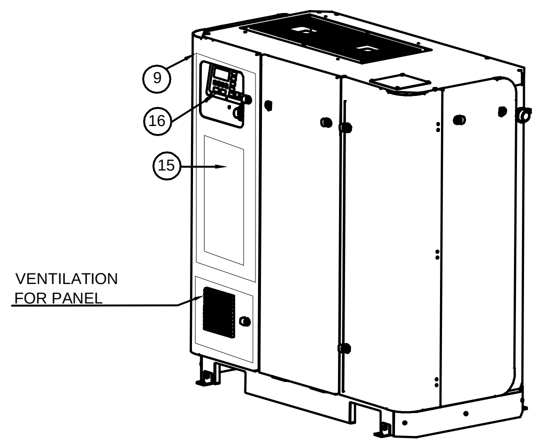
Load Combo	Description	D	Ex	Ey
1	(1.2+0.2SDS)+Ex	1.3422	1	0
2	(1.2+0.2SDS)+Ey	1.3422	0	1
3	(0.9-0.2SDS)+Ex	0.7578	1	0
4	(0.9-0.2SDS)+Ey	0.7578	0	1
5	(1.2+0.2SDS)+ΩoEx	1.3422	2	0
6	(1.2+0.2SDS)+ΩoEy	1.3422	0	2
7	(0.9-0.2SDS)+ΩoEx	0.7578	2	0
8	(0.9-0.2SDS)+ΩoEy	0.7578	0	2

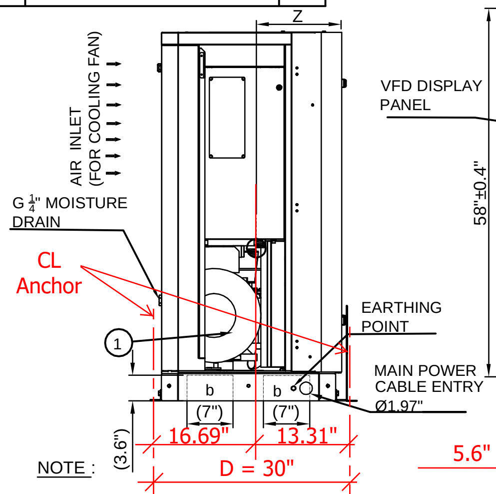
Load Combo	P_D	$(P_D)x$	$(P_D)y$	Ex	Ey	Mx	My	(T)Ex	(T)Ey
	[lbs]	[lbs]	[lbs]	[lbs]	[lbs]	[lbs-in]	[lbs-in]	[lbs]	[lbs]
1	1805.259	900.6147	800.9332	597.18	0	14105.39	0	314.8525	0
2	1805.259	900.6147	800.9332	0	597.18	0	14105.39	0	470.1797
3	1019.241	508.483	452.2033	597.18	0	14105.39	0	314.8525	0
4	1019.241	508.483	452.2033	0	597.18	0	14105.39	0	470.1797
5	1805.259	900.6147	800.9332	1194.36	0	28210.78	0	629.705	0
6	1805.259	900.6147	800.9332	0	1194.36	0	28210.78	0	940.3594
7	1019.241	508.483	452.2033	1194.36	0	28210.78	0	629.705	0
8	1019.241	508.483	452.2033	0	1194.36	0	28210.78	0	940.3594

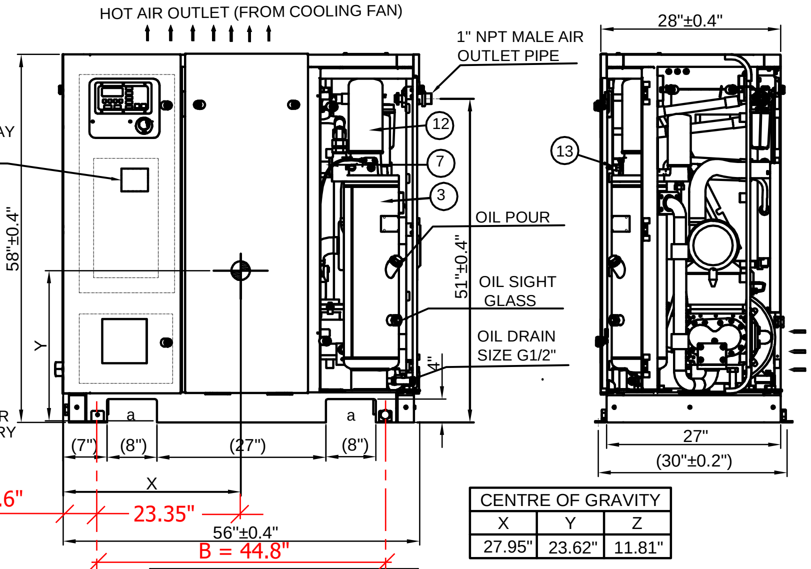
- CRITICAL CHARACTERISTIC (SAFETY/REGULATORY)
- SIGNIFICANT CHARACTERISTIC (FIT/FORM/FUNCTION/FINISH)

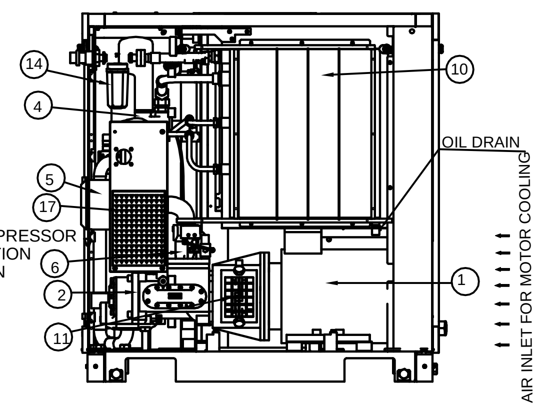
S.NO	DESCRIPTION	QTY
17	PRE FILTER	1
16	CONTROLLER	1
15	VARIABLE FREQUIENCY DRIVE (VFD)	1
14	MOISTURE SEPERATOR WITH ADV	1
13	SAFETY VALVE	1
12	AIR OIL SEPERATOR	1
11	DRIVE COUPLING	1
10	OIL AND AFTER COOLER ASSY	1
9	CONTROL PANEL	1
8	COOLER FAN	2*
7	MINIMUM PRESSURE VALVE	1
6	INTAKE VALVE	1
5	AIR FILTER	1
4	OIL FILTER	1
3	AIR - OIL SEPARATOR TANK	1
2	AIR END	1
1	MOTOR	1











CENTRE OF GRAVITY		
X	Y	Z
27.95"	23.62"	11.81"

NOTE :

1. [ ] Indicates Ducting Dimension
2. All dimensions without tolerance are for reference only
3. Cooling air flow for duct is 247202 ft³/hr.
   Pressure drop in conduit should not be more than 0.00435 psi g
4. Minimum distance required around the compressor is 3.3ft at all sides and 6.6ft at top (Installation requirement)
5. VFD available in CV version only
6. For EG 11 model fan qty 1 no mounted on Fan 2 position
7. For EG 15 to EG 22 models cooling fan qty 2 no's
8. 'a' mentioned place for fork lift access
9. 'b' mentioned place for pallet truck access

UNIT WEIGHT DETAILS (lbs)		
MODEL	C	CV
EG 11	1301	1410
EG 15	1344.8	1521
EG 18	1499	1565
EG 22	1521	1576

Sl.No	DESCRIPTION	Qty.	DRAWING No.	Rev.	REMARKS

MODEL.: EG 11,15,18,22 (USA & BRAZIL)

MATERIAL -

WEIGHT:

ELGI EQUIPMENTS LTD., COIMBATORE - INDIA.

GA DRAWING-EG SERIES C AND CV

	NAME	DATE
CAD	SS	31.01.17
CHECKED	SS	31.01.17
APPROVED	PMD	31.01.17

SCALE NTS

REF.DRG.No.

NEXT ASSY.

DRG.No. 01 53 1557 8

DRG.SHEET 1 OF 2

REVISION R01

REV. NO.	ECO.No.	DATE	DESCRIPTION	ALT. BY	CHKD. BY

ALL DIMENSIONS ARE IN inch UNLESS OTHERWISE SPECIFIED.

SURFACE FINISH SYMBOLS

MACHINING DEVIATION FOR OPEN DIMNS.IS 2102(Medium)

Company:	Martin and Libby	Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Compressor Anchorage	Date:	10/14/2021
Fastening point:			

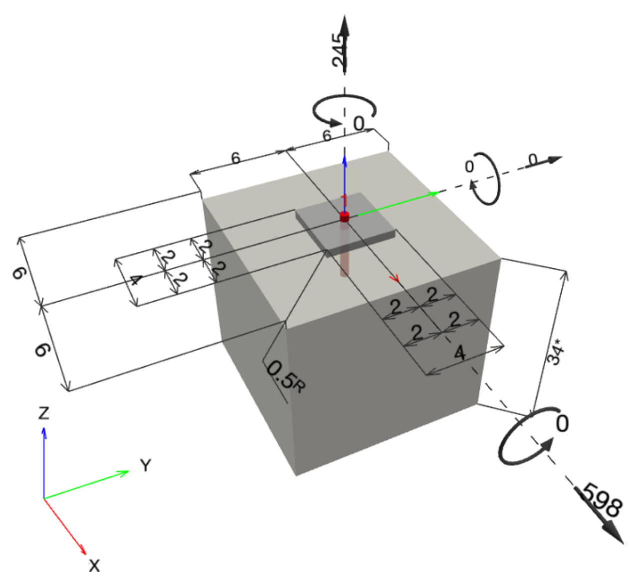
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ2 - SS 304 1/2 (3 1/4) hnom3**
Item number:	2210262 KB-TZ2 1/2x5 1/2 SS304
Effective embedment depth:	$h_{ef,act}$ = 3.250 in., h_{nom} = 3.750 in.
Material:	AISI 304
Evaluation Service Report:	ESR-4266
Issued I Valid:	3/1/2021 | 12/1/2021
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate^R :	l_x x l_y x t = 4.000 in. x 4.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 34.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d)) Shear load: yes (17.10.6.3 (c))

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

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



Hilti PROFIS Engineering 3.1.1

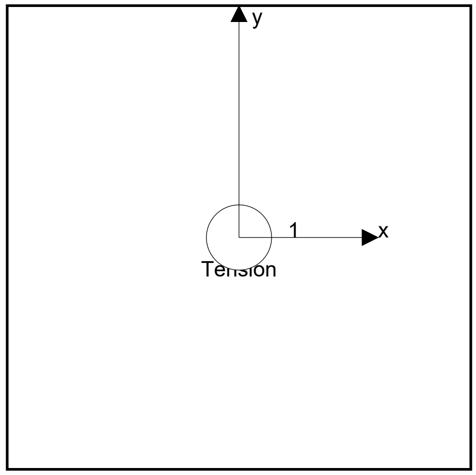
www.hilti.com

Company:	Martin and Libby	Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Compressor Anchorage	Date:	10/14/2021
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 245; V_x = 598; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	25

2 Load case/Resulting anchor forces



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	245	598	598	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 245 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

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

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	245	8,906	3	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	245	2,660	10	OK

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

Company:	Martin and Libby	Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Compressor Anchorage	Date:	10/14/2021
Fastening point:			

3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-4266

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.10	120,404

Calculations

N_{sa} [lb]
11,875

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
11,875	0.750	1.000	8,906	245

3.2 Concrete Breakout Failure

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

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
3.250	6.000	1.000	8.000	17	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
95.06	95.06	1.000	1.000	5,455

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
5,455	0.650	0.750	1.000	2,660	245

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	598	5,426	12	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	598	7,638	8	OK
Concrete edge failure in direction x+**	598	2,433	25	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-4266

ϕ $V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.10	120,404	1.000

Calculations

$V_{sa,eq}$ [lb]
8,348

Results

$V_{sa,eq}$ [lb]	ϕ $_{steel}$	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
8,348	0.650	1.000	5,426	598

4.2 Pryout Strength

$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$	ACI 318-19 Eq. (17.7.3.1a)
$\phi\ V_{cp} \geq V_{ua}$	ACI 318-19 Table 17.5.2
A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)	
$A_{Nc0} = 9\ h_{ef}^2$	ACI 318-19 Eq. (17.6.2.1.4)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.4.1b)
$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.6.1b)
$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$	ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2	3.250	6.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
8.000	17	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
95.06	95.06	1.000	1.000	5,455

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
10,911	0.700	1.000	1.000	7,638	598

4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V} \, \psi_{c,V} \, \psi_{h,V} \, \psi_{parallel,V} \, V_b$	ACI 318-19 Eq. (17.7.2.1a)
$\phi \; V_{cb} \geq V_{ua}$	ACI 318-19 Table 17.5.2
A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)	
$A_{Vc0} = 4.5 \, c_{a1}^2$	ACI 318-19 Eq. (17.7.2.1.3)
$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$	ACI 318-19 Eq. (17.7.2.4.1b)
$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$	ACI 318-19 Eq. (17.7.2.6.1)
$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c} \, c_{a1}^{1.5}$	ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
6.000	6.000	1.000	34.000	3.250

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.500	3,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
108.00	162.00	0.900	1.000	5,794

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \; V_{cb}$ [lb]	V_{ua} [lb]
3,476	0.700	1.000	1.000	2,433	598

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.092	0.246	5/3	12	OK

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

Company:	Martin and Libby	Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Compressor Anchorage	Date:	10/14/2021
Fastening point:			

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

Computed By : **JAS**	Date: **10/14/2021**	Checked By :	Date:	Sheet No 5
Project No. 7396	Note No.	Subject: PEC N2 Gen Set		

Refrigerated Air Dryer Anchorage Forces

- See attached spreadsheet for anchor force calculation.
- Loads provided are factored using LFRD load combinations.

$$\mathrm{T} = \frac{43\ \mathrm{lbs}}{2\ \mathrm{Anchors}} = 22\frac{\mathrm{lbs}}{\mathrm{Anchor}}\mathrm{MAX}$$

$$\mathrm{P_D} = \frac{34\ \mathrm{lbs}}{2\ \mathrm{Anchors}} = 17\frac{\mathrm{lbs}}{\mathrm{Anchor}}\mathrm{MIN}$$

$$\mathrm{T_{net}} = 22 - 17 = 5\ \mathrm{lbs\ Uplift}$$

$$\mathrm{T_\Omega} = \frac{87\ \mathrm{lbs}}{2\ \mathrm{Anchors}} = 44\frac{\mathrm{lbs}}{\mathrm{Anchor}}\mathrm{MAX}$$

$$\mathrm{P_D} = \frac{34\ \mathrm{lbs}}{2\ \mathrm{Anchors}} = 17\frac{\mathrm{lbs}}{\mathrm{Anchor}}\mathrm{MIN}$$

$$T_{\Omega\,NET} = 44 - 17 = 27\ lbs\ Uplift$$

$$V_\Omega = \frac{82\ lbs}{2\ anchors\ min} = 41\ lbs$$

Use 1/4" diameter x 1.5” Embed Hilti KB-TZ2 A304 SS Minimum. Maintain 6” edge distance and anchor spacing all sides

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 GLACIER AVE.
SAN DIEGO, CA 92120

Computed By: __________ Date: ______________ Checked By: ______________ Date ____________ Sheet No. ____ Of ____

Project No. ____________ Note No. __________ Subject ____

Anchorage Force Calculation

Equipment: Refrigerated Air Dryer

Equipment Parameters

Height, H =	19	[in]
CL Anchor Width, B =	14	[in] (Assume anchors 3" inboard from unit edge)
CL Anchor Depth, D =	12	[in] (Assume anchors 1.5" inboard from unit edge)
Center of Gravity, X =	7	[in] (Assume at CL unit)
Center of Gravity, Y =	12.7	[in] (Veritcal, Assume at 2/3 height)
Center of Gravity, Z =	6	[in] (Assume at CL unit)
Operating Weigth, W =	92	[lbs]
SDS =	0.711	
Base Shear Coeff. =	0.444	
SDS =	0.711	
Ωo =	2	

Load Combinations

Load Combo	Description	D	Ex	Ey
1	(1.2+0.2SDS)+Ex	1.3422	1	0
2	(1.2+0.2SDS)+Ey	1.3422	0	1
3	(0.9-0.2SDS)+Ex	0.7578	1	0
4	(0.9-0.2SDS)+Ey	0.7578	0	1
5	(1.2+0.2SDS)+ΩoEx	1.3422	2	0
6	(1.2+0.2SDS)+ΩoEy	1.3422	0	2
7	(0.9-0.2SDS)+ΩoEx	0.7578	2	0
8	(0.9-0.2SDS)+ΩoEy	0.7578	0	2

Load Combo	P_D	$(P_D)x$	$(P_D)y$	Ex	Ey	Mx	My	(T)Ex	(T)Ey
	[lbs]	[lbs]	[lbs]	[lbs]	[lbs]	[lbs-in]	[lbs-in]	[lbs]	[lbs]
1	123.4824	61.7412	61.7412	40.848	0	518.7696	0	37.05497	0
2	123.4824	61.7412	61.7412	0	40.848	0	518.7696	0	43.2308
3	69.7176	34.8588	34.8588	40.848	0	518.7696	0	37.05497	0
4	69.7176	34.8588	34.8588	0	40.848	0	518.7696	0	43.2308
5	123.4824	61.7412	61.7412	81.696	0	1037.539	0	74.10994	0
6	123.4824	61.7412	61.7412	0	81.696	0	1037.539	0	86.4616
7	69.7176	34.8588	34.8588	81.696	0	1037.539	0	74.10994	0
8	69.7176	34.8588	34.8588	0	81.696	0	1037.539	0	86.4616

Direct Expansion Refrigerated Air Dryers

Clean and dry compressed air is essential in every efficient and profitable manufacturing and process operation worldwide. Our vast experience includes food, beverage, chemical, laboratory, medical and natural gas applications.

South-Tek Systems Direct Expansion Refrigerated Air Dryers are designed and manufactured to efficiently remove moisture from compressed air and assure a reliable supply of dry air.

Features & Benefits

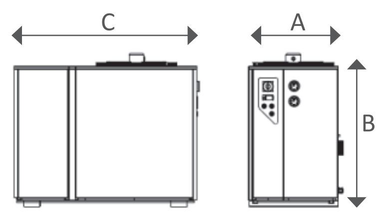
Automatic Expansion Valve
The TXV ensures stable dew point performance even in changing ambient conditions.
Refrigerant Gauge Standard
Refrigerant gauge is located above the controller for ease of troubleshooting.
Easy Installation and Start-Up
Small footprint, lightweight and ready to go out of the box.
Adjustable Timer Drain Standard
Timed solenoid drain is fully adjustable and extremely reliable.
Environmentally Friendly
R134a and R407C refrigerants are recognized as both efficient and safe.
Robust Construction
Powder coated galvanized steel panels are corrosion resistant.

Stainless Steel Heat Exchanger
With a patented design, corrosion resistant construction and integrated moisture separator, the large surface area heat exchanger is truly unique and efficient.

CAREL Microprocessor
Functionality monitoring text display includes power on, dew point temperature, drain operation and manual override.

Technical Specification

Model	Inlet & Outlet [1]	Rated Flow [2]		Absorbed Power [3]	Dimensions (inches)			Approx. Weight	Power Supply (V/Ph/60Hz) [4]		
	NPT/FLG	scfm	Nm³/h	kW	A	B	C	lbs	115/1	230/1	460/3
003-191	½"	15	24	0.22	15	17	18	55	●		
003-192	½"	20	32	0.23	15	17	18	62	●		
003-193	½"	30	48	0.24	15	17	18	70	●		
003-194	½"	45	72	0.25	15	17	18	77	●		
003-195	¾"	55	88	0.47	15	19	20	84	●		
003-196	¾"	85	136	0.49	15	19	20	92	●		
003-197	1"	110	177	0.92	15	26	29	143	●		
003-198	1"	135	217	0.92	15	26	29	143	●		
003-199	1½"	175	281	0.96	15	26	29	152	●		
003-200	1½"	215	345	0.94	16	30	35	196		●	
003-201	2"	250	401	1.47	18	35	47	253			●
003-202	2"	340	546	1.47	18	35	47	253		●	●
003-203	2"	470	754	2.50	18	35	47	297			●
003-204	2½"	550	883	2.60	18	35	47	319			●
003-220	2½"	725	1164	3.46	18	35	47	397			●
003-221	2½"	950	1525	3.60	23	40	47	712			●
003-222	3"	1150	1846	5.04	23	40	47	771			●
003-223	3"	1350	2167	6.54	23	40	47	882			●
003-224	4" Flg	1750	2809	7.20	73	64	40	1433			●
003-225	4" Flg	2000	3210	7.20	73	64	40	1480			●



Specifications

Design operating pressure range	0 to 232 psig
Maximum inlet temperature	158°F
Maximum ambient temperature	110°F - 122°F depending on refrigerant (contact support for details)

Pressure Correction Factors [5]

Inlet air pressure (psig)	58	72	87	100	115	130	145	160	175	190	204**	218**	232**
Correction factor	0.72	0.82	0.92	1.00	1.06	1.09	1.11	1.15	1.18	1.19	1.21	1.23	1.26

Inlet Temperature Correction Factors [5]

Inlet air temperature (°F)	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
Correction factor	1.27	1.19	1.09	1.00	0.91	0.78	0.71	0.63	0.56	0.52	0.48	0.44	0.40	0.36	0.33

Ambient Temperature Correction Factors [5]

Ambient temperature (°F)	70	80	90	100	105	110
Correction factor	1.18	1.16	1.06	1.00	0.96	0.90

(1) ½" to 2 ½" are NPT threaded connections, 4" and up are supplied with ANSI flanged connections.
(2) Rated flow capacity: conditions for rating dryers are in accordance with ISO7183 (Option A2). Compressed air at dryer inlet: 100 psig (7 bar) and 100°F (38°C); ambient air temperature: 100°F (38°C); operating on 60Hz power supply.
(3) Nominal absorbed power at rated operating conditions using 115/1/60 or 460/3/60 power supply (as applicable). For absorbed power at other voltages or conditions, contact South-Tek Systems.
(4) Specify voltage requirements when ordering. For 575V applications, contact South-Tek Systems for assistance.
(5) To be used as a rough guide only. All applications should be confirmed by sizing software. Contact South-Tek Systems for sizing assistance.

**2 year warranty with pre-filtration and non-corrosive piping system installed.*
***Applies to 003-220 and below only.*

South-Tek Systems
www.southteksystems.com
Tel (888) 526-6284

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

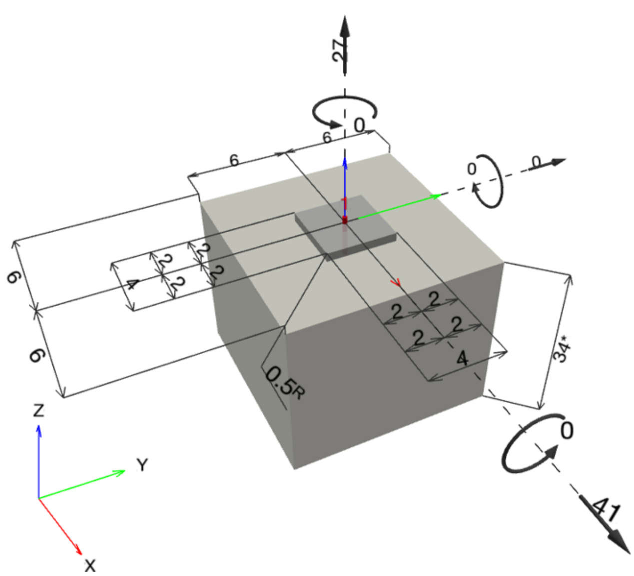
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ2 - SS 304 1/4**
Item number:	2210179 KB-TZ2 1/4x3 1/4 SS304
Effective embedment depth:	$h_{ef,act}$ = 1.500 in., h_{nom} = 1.750 in.
Material:	AISI 304
Evaluation Service Report:	ESR-4266
Issued I Valid:	3/1/2021 | 12/1/2021
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate[R] :	l_x x l_y x t = 4.000 in. x 4.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 34.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

[R] - The anchor calculation is based on a rigid anchor plate assumption.

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



Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 27; V_x = 41; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	11

2 Load case/Resulting anchor forces

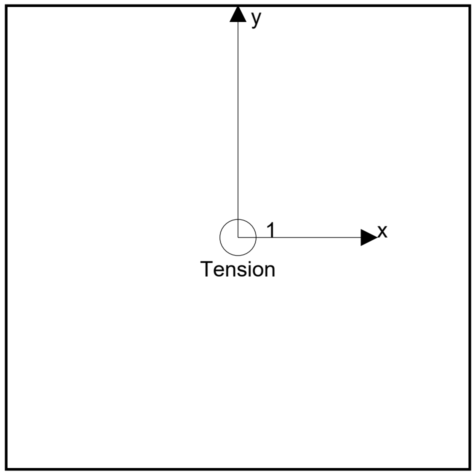
Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	27	41	41	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 27 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

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



3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	27	2,191	2	OK
Pullout Strength*	27	248	11	OK
Concrete Breakout Failure**	27	577	5	OK

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

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-4266

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.02	122,404

Calculations

N_{sa} [lb]
2,921

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
2,921	0.750	1.000	2,191	27

3.2 Pullout Strength

$N_{pn,f'_c} = N_{p,2500}\ \lambda_a\ (f_c'/2500)^{0.5}$ — refer to ICC-ES ESR-4266

$\phi\ N_{pn,f'_c} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

f'_c [psi]	λ_a	$N_{p,2500}$ [lb]
3,000	1.000	670

Calculations

$(f_c'/2500)^{0.5}$
1.095

Results

N_{pn,f'_c} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{pn,f'_c}$ [lb]	N_{ua} [lb]
734	0.450	0.750	1.000	248	27

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

3.3 Concrete Breakout Failure

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

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.500	6.000	1.000	4.000	17	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
20.25	20.25	1.000	1.000	1,711

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
1,711	0.450	0.750	1.000	577	27

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	41	722	6	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	41	1,197	4	OK
Concrete edge failure in direction x+**	41	1,693	3	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-4266

ϕ $V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.02	122,404	0.760

Calculations

$V_{sa,eq}$ [lb]
1,110

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
1,110	0.650	1.000	722	41

Company:	Martin and Libby	Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

4.2 Pryout Strength

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

$\phi\ V_{cp} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
1	1.500	6.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
4.000	17	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
20.25	20.25	1.000	1.000	1,711

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
1,711	0.700	1.000	1.000	1,197	41

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ — ACI 318-19 Eq. (17.7.2.1a)

$\phi\ V_{cb} \geq V_{ua}$ — ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ — ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ — ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
6.000	6.000	1.000	34.000	1.500

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.250	3,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
108.00	162.00	0.900	1.000	4,032

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
2,419	0.700	1.000	1.000	1,693	41

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.109	0.057	5/3	4	OK

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

Company:	Martin and Libby	Page:	8
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Refrigerated Air Dryer Anchorage	Date:	10/14/2021
Fastening point:			

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

240 GA Air Tank Anchorage Forces

- See attached spreadsheet for anchor force calculation.
- Loads provided are factored using LFRD load combinations.

$$T = 568 \frac{lbs}{Anchor} MAX$$

$$P_D = \frac{205.4\ lbs}{2\ Anchors} = 102 \frac{lbs}{Anchor} MIN$$

$$T_{net} = 568 - 102 = 466\ lbs\ Uplift$$

$$T_\Omega = 1135 \frac{lbs}{Anchor} MAX$$

$$P_D = \frac{205.4\ lbs}{2\ Anchors} = 102 \frac{lbs}{Anchor} MIN$$

$$T_{\Omega\ NET} = 1135 - 102 = 1033\ lbs\ Uplift$$

$$V_\Omega = \frac{482\ lbs}{2\ anchors\ min} = 241\ lbs$$

Use 5/8" diameter x 3.25” Embed Hilti KB-TZ2 A304 SS. Maintain 6” edge distance and anchor spacing all sides

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 GLACIER AVE.
SAN DIEGO, CA 92120

Computed By: _______ Date: _______ Checked By: _______ Date _______ Sheet No. ___ Of ___

Project No. _______ Note No. _______ Subject _______

Anchorage Force Calculation

Equipment: 240 Gallon Air Tank

Equipment Parameters

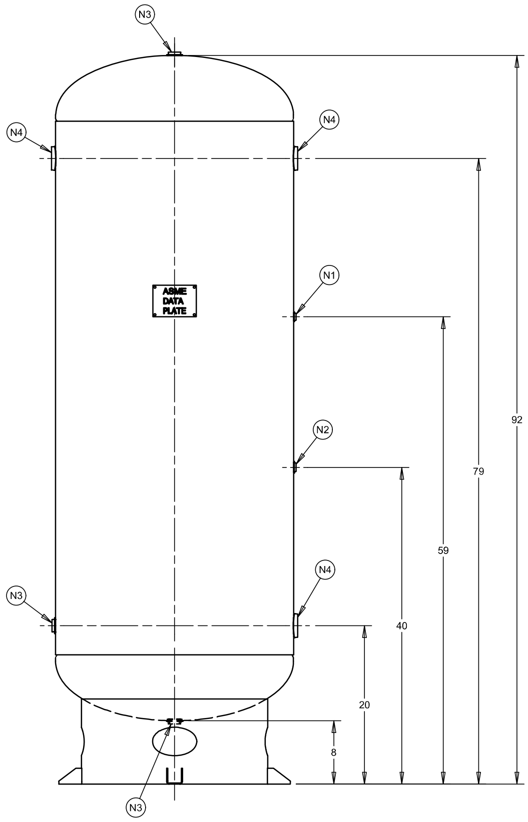
Height, H =	92	[in]
CL Anchor Width, B =	26	[in]
CL Anchor Depth, D =	26	[in]
Center of Gravity, X =	13	[in] (Assume at CL unit)
Center of Gravity, Y =	61.3	[in] (Veritcal, Assume at 2/3 height)
Center of Gravity, Z =	13	[in] (Assume at CL unit)
Operating Weigth, W =	542	[lbs]
SDS =	0.711	
Base Shear Coeff. =	0.444	
SDS =	0.711	
Ωo =	2	

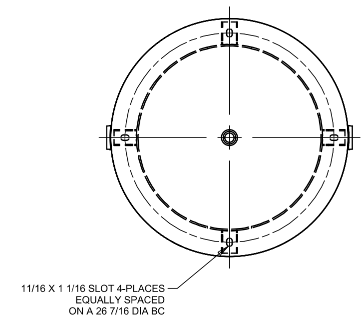
Load Combinations

Load Combo	Description	D	Ex	Ey
1	(1.2+0.2SDS)+Ex	1.3422	1	0
2	(1.2+0.2SDS)+Ey	1.3422	0	1
3	(0.9-0.2SDS)+Ex	0.7578	1	0
4	(0.9-0.2SDS)+Ey	0.7578	0	1
5	(1.2+0.2SDS)+ΩoEx	1.3422	2	0
6	(1.2+0.2SDS)+ΩoEy	1.3422	0	2
7	(0.9-0.2SDS)+ΩoEx	0.7578	2	0
8	(0.9-0.2SDS)+ΩoEy	0.7578	0	2

Load Combo	P_D	$(P_D)x$	$(P_D)y$	Ex	Ey	Mx	My	(T)Ex	(T)Ey
	[lbs]	[lbs]	[lbs]	[lbs]	[lbs]	[lbs-in]	[lbs-in]	[lbs]	[lbs]
1	727.4724	363.7362	363.7362	240.648	0	14751.72	0	567.3739	0
2	727.4724	363.7362	363.7362	0	240.648	0	14751.72	0	567.3739
3	410.7276	205.3638	205.3638	240.648	0	14751.72	0	567.3739	0
4	410.7276	205.3638	205.3638	0	240.648	0	14751.72	0	567.3739
5	727.4724	363.7362	363.7362	481.296	0	29503.44	0	1134.748	0
6	727.4724	363.7362	363.7362	0	481.296	0	29503.44	0	1134.748
7	410.7276	205.3638	205.3638	481.296	0	29503.44	0	1134.748	0
8	410.7276	205.3638	205.3638	0	481.296	0	29503.44	0	1134.748

NOZZLE CHART	
NOZZLE ID	NPT SIZE
N1	1/4
N2	1/2
N3	1
N4	2





TOP VIEW

DESIGN INFORMATION	
SPECIFICATION	VALUE
DIAMETER O.D./I.D.	30 O.D.
MAWP	200 PSI AT 400°F
MDMT	-20°F AT 200 PSI
CAPACITY	APPROX 240 GALLONS
SHIPPING WEIGHT	542 LBS
CRN	L4036.5C

TITLE
VERTICAL AIR RECEIVER

SAMUEL PRESSURE VESSEL GROUP

CUSTOMER	TYPE	DRAWN	CHECKED	DRAWING NO	REV
STOCK	ASME	KAT 9/9/2016	DMM 10/7/2016	A10053	A16
		SIZE: B	SHEET 1 OF 1		

REV	DESCRIPTION	BY	DATE
A16	ISSUED		

(BUILT IN ACCORDANCE WITH LATEST EDITION OF SECTION VIII DIV 1 ASME CODE) www.hilti.com

Company:	Martin and Libby	Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Tank Anchorage	Date:	10/14/2021
Fastening point:			

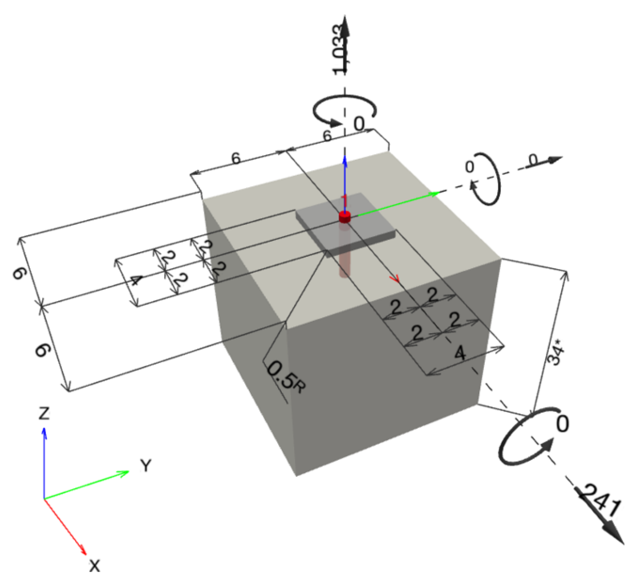
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ2 - SS 304 5/8 (3 1/4) hnom2**
Item number:	2210279 KB-TZ2 5/8x6 SS304
Effective embedment depth:	$h_{ef,act}$ = 3.250 in., h_{nom} = 3.750 in.
Material:	AISI 304
Evaluation Service Report:	ESR-4266
Issued I Valid:	3/1/2021 | 12/1/2021
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate[R] :	l_x x l_y x t = 4.000 in. x 4.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 34.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

[R] - The anchor calculation is based on a rigid anchor plate assumption.

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



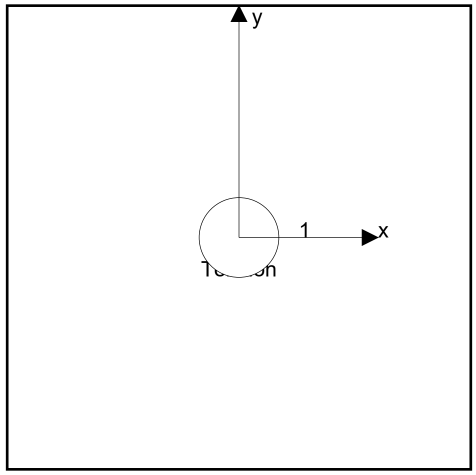
www.hilti.com

Company:	Martin and Libby	Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Tank Anchorage	Date:	10/14/2021
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 1,033; V_x = 241; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	32

2 Load case/Resulting anchor forces



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1,033	241	241	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 1,033 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

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

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	1,033	14,132	8	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	1,033	3,285	32	OK

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

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Tank Anchorage	Date:	10/14/2021
Fastening point:			

3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-4266

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.16	114,604

Calculations

N_{sa} [lb]
18,843

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
18,843	0.750	1.000	14,132	1,033

3.2 Concrete Breakout Failure

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

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
3.250	6.000	1.000	7.000	21	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
95.06	95.06	1.000	1.000	6,739

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
6,739	0.650	0.750	1.000	3,285	1,033

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Tank Anchorage	Date:	10/14/2021
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	241	8,034	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	241	9,435	3	OK
Concrete edge failure in direction x+**	241	2,602	10	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-4266

ϕ $V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.16	114,604	1.000

Calculations

$V_{sa,eq}$ [lb]
12,360

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
12,360	0.650	1.000	8,034	241

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Tank Anchorage	Date:	10/14/2021
Fastening point:			

4.2 Pryout Strength

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

$\phi\ V_{cp} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2	3.250	6.000	1.000

c_{ac} [in.]	k_c	λ_a	f_c' [psi]
7.000	21	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
95.06	95.06	1.000	1.000	6,739

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
13,478	0.700	1.000	1.000	9,435	241

Hilti PROFIS Engineering 3.1.1

4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ — ACI 318-19 Eq. (17.7.2.1a)

$\phi\ V_{cb} \geq V_{ua}$ — ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ — ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ — ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
6.000	6.000	1.000	34.000	3.250

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.625	3,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
108.00	162.00	0.900	1.000	6,195

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
3,717	0.700	1.000	1.000	2,602	241

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.314	0.093	5/3	17	OK

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

Company:	Martin and Libby	Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Air Tank Anchorage	Date:	10/14/2021
Fastening point:			

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

Nitrogen Generator Anchorage Forces

- See attached spreadsheet for anchor force calculation.
- Loads provided are factored using LFRD load combinations.

$$T = \frac{978\ lbs}{2\ Anchors} = 489\frac{lbs}{Anchor}MAX$$

$$P_D = \frac{404\ lbs}{2\ Anchors} = 202\frac{lbs}{Anchor}MIN$$

$$T_{net} = 489 - 202 = 287\ lbs\ Uplift$$

$$T_{\Omega} = \frac{1956\ lbs}{2\ Anchors} = 978\frac{lbs}{Anchor}MAX$$

$$P_D = \frac{404\ lbs}{2\ Anchors} = 202\frac{lbs}{Anchor}MIN$$

$$T_{\Omega\ NET} = 978 - 202 = 776\ lbs\ Uplift$$

$$V_{\Omega} = \frac{1421\ lbs}{2\ anchors\ min} = 711\ lbs$$

Use 3/8" diameter x 2.5” Embed Hilti KB-TZ2 A304 SS. Maintain 6” edge distance and anchor spacing all sides

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 GLACIER AVE.
SAN DIEGO, CA 92120

Computed By: ________ Date: ________ Checked By: ________ Date ________ Sheet No. ____ Of ____

Project No. ________ Note No. ________ Subject ________________

Anchorage Force Calculation

Equipment: Nitrogen Generator

Equipment Parameters

Height, H =	62	[in]
CL Anchor Width, B =	30	[in]
CL Anchor Depth, D =	33	[in]
Center of Gravity, X =	10	[in] (Assume at 1/3 width of unit)
Center of Gravity, Y =	41.3	[in] (Veritcal, Assume at 2/3 height)
Center of Gravity, Z =	16.5	[in] (Assume at CL unit)
Operating Weigth, W =	1600	[lbs]
SDS =	0.711	
Base Shear Coeff. =	0.444	
SDS =	0.711	
Ωo =	2	

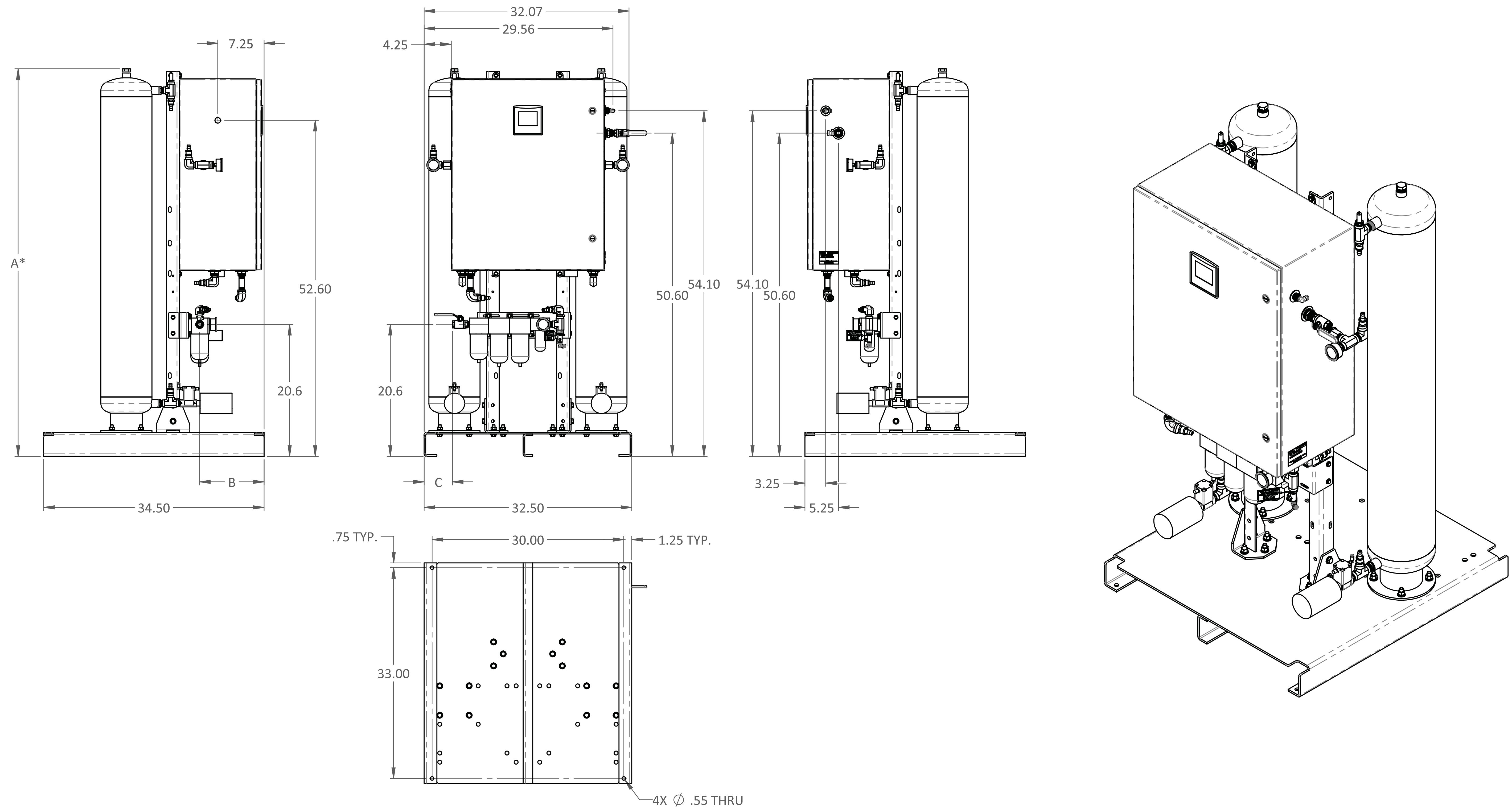
Load Combinations

Load Combo	Description	D	Ex	Ey
1	(1.2+0.2SDS)+Ex	1.3422	1	0
2	(1.2+0.2SDS)+Ey	1.3422	0	1
3	(0.9-0.2SDS)+Ex	0.7578	1	0
4	(0.9-0.2SDS)+Ey	0.7578	0	1
5	(1.2+0.2SDS)+ΩoEx	1.3422	2	0
6	(1.2+0.2SDS)+ΩoEy	1.3422	0	2
7	(0.9-0.2SDS)+ΩoEx	0.7578	2	0
8	(0.9-0.2SDS)+ΩoEy	0.7578	0	2

Load Combo	P_D	$(P_D)x$	$(P_D)y$	Ex	Ey	Mx	My	(T)Ex	(T)Ey
	[lbs]	[lbs]	[lbs]	[lbs]	[lbs]	[lbs-in]	[lbs-in]	[lbs]	[lbs]
1	2147.52	715.84	1073.76	710.4	0	29339.52	0	977.984	0
2	2147.52	715.84	1073.76	0	710.4	0	29339.52	0	889.0764
3	1212.48	404.16	606.24	710.4	0	29339.52	0	977.984	0
4	1212.48	404.16	606.24	0	710.4	0	29339.52	0	889.0764
5	2147.52	715.84	1073.76	1420.8	0	58679.04	0	1955.968	0
6	2147.52	715.84	1073.76	0	1420.8	0	58679.04	0	1778.153

*OVERALL HEIGHT - THIS DIMENSIONS MAY FALL AT THE TOP OF THE SIEVE BEDS (AS SHOWN) OR AT THE TOP OF THE ELECTRICAL ENCLOSURE STAND DEPENDING ON MODEL.

MODEL #	A	B	C
PCS-220	75.38	8.84	0.92



REV	ECR#	SHEET	DESCRIPTION	DATE	DRAWN	APPR.
-	-		-	-	-	-
-	-		-	-	-	-
00	-		INITIAL RELEASE	08/10/16	CDB	MRT

REVISIONS: ONLY THE LATEST 3 REVISIONS WILL BE SHOWN. OLDER REVISIONS CONSOLIDATED AND FILED.

South-Tek Systems

PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SOUTH-TEK SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF SOUTH-TEK SYSTEMS IS PROHIBITED.

MATERIAL:

FINISH:

WEIGHT:

PROJECT NAME: KAAM GROUP INC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
WHOLE NUMBER DIM's: ± 1
ONE DEC.: ± .2, TWO DEC.: ± .02
THREE DEC.: ± .005 , ANG.: ± .05°

CS MODEL DETAIL DRAWING

DRAWN: CDB
APPROVED: JVN
DATE: 08/10/16
DATE: 08/19/16
SIZE: B
SCALE: N.T.S.
SHEET: 1 OF 1

NUMBER: PCS-220-TYP-D

REVISION: 00

www.hilti.com

Company:	Martin and Libby	Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Generator Anchorage	Date:	10/14/2021
Fastening point:			

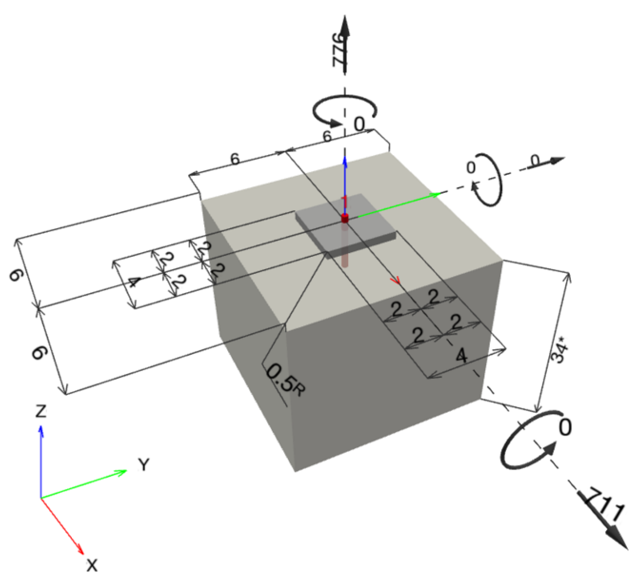
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ2 - SS 304 3/8 (2 1/2) hnom3**
Item number:	2210245 KB-TZ2 3/8x5 SS304
Effective embedment depth:	$h_{ef,act}$ = 2.500 in., h_{nom} = 3.000 in.
Material:	AISI 304
Evaluation Service Report:	ESR-4266
Issued I Valid:	3/1/2021 | 12/1/2021
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate[R] :	l_x x l_y x t = 4.000 in. x 4.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 34.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

[R] - The anchor calculation is based on a rigid anchor plate assumption.

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



Hilti PROFIS Engineering 3.1.1

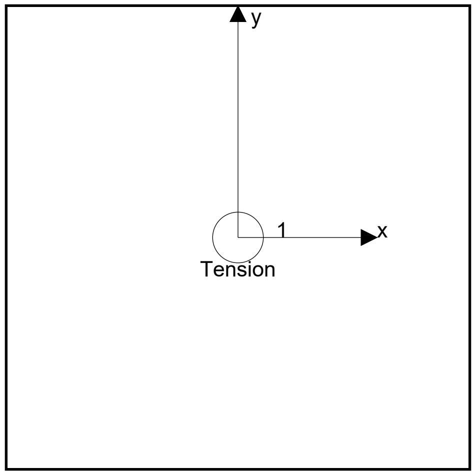
www.hilti.com

Company:	Martin and Libby	Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Generator Anchorage	Date:	10/14/2021
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 776; V_x = 711; V_y = 0;$ $M_x = 0; M_y = 0; M_z = 0;$	yes	44

2 Load case/Resulting anchor forces



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	776	711	711	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 776 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

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

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	776	4,637	17	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	776	1,794	44	OK

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

Company:	Martin and Libby	Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Generator Anchorage	Date:	10/14/2021
Fastening point:			

3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-4266

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.05	120,104

Calculations

N_{sa} [lb]
6,182

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
6,182	0.750	1.000	4,637	776

3.2 Concrete Breakout Failure

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

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.500	6.000	1.000	4.000	17	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
56.25	56.25	1.000	1.000	3,681

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
3,681	0.650	0.750	1.000	1,794	776

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Generator Anchorage	Date:	10/14/2021
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	711	3,177	23	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	711	5,153	14	OK
Concrete edge failure in direction x+**	711	2,118	34	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-4266
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.05	120,104	1.000

Calculations

$V_{sa,eq}$ [lb]
4,887

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ V_{sa,eq}$ [lb]	V_{ua} [lb]
4,887	0.650	1.000	3,177	711

4.2 Pryout Strength

$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$	ACI 318-19 Eq. (17.7.3.1a)
$\phi\ V_{cp} \geq V_{ua}$	ACI 318-19 Table 17.5.2
A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)	
$A_{Nc0} = 9\ h_{ef}^2$	ACI 318-19 Eq. (17.6.2.1.4)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.4.1b)
$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.6.1b)
$N_b = k_c\ \lambda_a \sqrt{f'_c}\ h_{ef}^{1.5}$	ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2	2.500	6.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
4.000	17	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
56.25	56.25	1.000	1.000	3,681

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
7,361	0.700	1.000	1.000	5,153	711

Company:	Martin and Libby	Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Generator Anchorage	Date:	10/14/2021
Fastening point:			

4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V} \; \psi_{c,V} \; \psi_{h,V} \; \psi_{parallel,V} \, V_b$ ACI 318-19 Eq. (17.7.2.1a)

$\phi \; V_{cb} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5 \, c_{a1}^2$ ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c} \, c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
6.000	6.000	1.000	34.000	2.500

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.375	3,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
108.00	162.00	0.900	1.000	5,043

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \; V_{cb}$ [lb]	V_{ua} [lb]
3,026	0.700	1.000	1.000	2,118	711

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.432	0.336	5/3	41	OK

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

www.hilti.com

Company:	Martin and Libby	Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Generator Anchorage	Date:	10/14/2021
Fastening point:			

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

400 GA Nitrogen Tank Anchorage Forces

- See attached spreadsheet for anchor force calculation.
- Loads provided are factored using LFRD load combinations.

$$T = 3243 \frac{lbs}{Anchor} MAX$$

$$P_D = \frac{2604\ lbs}{2\ Anchors} = 651 \frac{lbs}{Anchor} MIN$$

$$T_{net} = 3243 - 651 = 2592\ lbs\ Uplift$$

$$T_{\Omega} = 6486 \frac{lbs}{Anchor} MAX$$

$$P_D = \frac{2604\ lbs}{2\ Anchors} = 651 \frac{lbs}{Anchor} MIN$$

$$T_{\Omega\,NET} = 6486 - 651 = 5835\ lbs\ Uplift$$

$$V_{\Omega} = \frac{3052\ lbs}{2\ anchors\ min} = 1526\ lbs$$

Use 5/8" diameter HAS-R A304 SS threaded rod x 8” Embed Hilti HIT-HY 200 Epoxy. Maintain 8” edge distance and anchor spacing all sides.

MARTIN & LIBBY
STRUCTURAL ENGINEERS
4452 GLACIER AVE.
SAN DIEGO, CA 92120

Computed By: ________ Date: ________ Checked By: ________ Date ________ Sheet No. ____ Of ____

Project No. ________ Note No. ________ Subject ________

Anchorage Force Calculation

Equipment: 400 Gallon Nitrogen Tank

Equipment Parameters

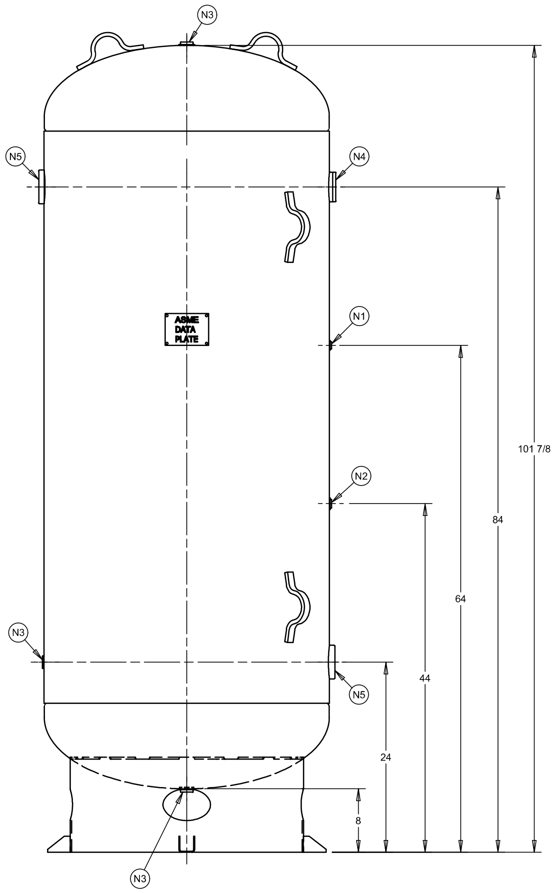
Height, H =	102	[in]
CL Anchor Width, B =	32	[in]
CL Anchor Depth, D =	32	[in]
Center of Gravity, X =	16	[in] (Assume at CL unit)
Center of Gravity, Y =	68	[in] (Veritcal, Assume at 2/3 height)
Center of Gravity, Z =	16	[in] (Assume at CL unit)
Operating Weigth, W =	3437	[lbs]
SDS =	0.711	
Base Shear Coeff. =	0.444	
SDS =	0.711	
Ωo =	2	

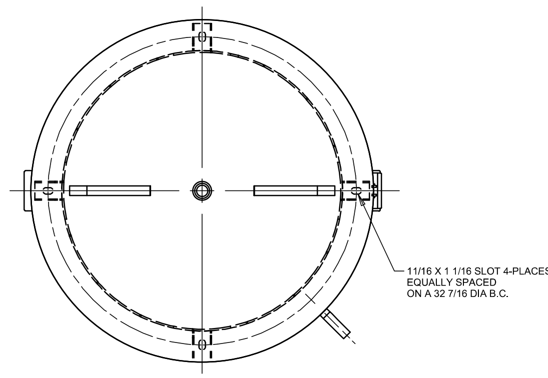
Load Combinations

Load Combo	Description	D	Ex	Ey
1	(1.2+0.2SDS)+Ex	1.3422	1	0
2	(1.2+0.2SDS)+Ey	1.3422	0	1
3	(0.9-0.2SDS)+Ex	0.7578	1	0
4	(0.9-0.2SDS)+Ey	0.7578	0	1
5	(1.2+0.2SDS)+ΩoEx	1.3422	2	0
6	(1.2+0.2SDS)+ΩoEy	1.3422	0	2
7	(0.9-0.2SDS)+ΩoEx	0.7578	2	0
8	(0.9-0.2SDS)+ΩoEy	0.7578	0	2

Load Combo	P_D	$(P_D)x$	$(P_D)y$	Ex	Ey	Mx	My	(T)Ex	(T)Ey
	[lbs]	[lbs]	[lbs]	[lbs]	[lbs]	[lbs-in]	[lbs-in]	[lbs]	[lbs]
1	4613.1414	2306.571	2306.571	1526.028	0	103769.9	0	3242.81	0
2	4613.1414	2306.571	2306.571	0	1526.028	0	103769.9	0	3242.81
3	2604.5586	1302.279	1302.279	1526.028	0	103769.9	0	3242.81	0
4	2604.5586	1302.279	1302.279	0	1526.028	0	103769.9	0	3242.81
5	4613.1414	2306.571	2306.571	3052.056	0	207539.8	0	6485.619	0
6	4613.1414	2306.571	2306.571	0	3052.056	0	207539.8	0	6485.619
7	2604.5586	1302.279	1302.279	3052.056	0	207539.8	0	6485.619	0
8	2604.5586	1302.279	1302.279	0	3052.056	0	207539.8	0	6485.619

NOZZLE CHART	
NOZZLE ID	NPT SIZE
N1	1/4
N2	1/2
N3	1
N4	2 1/2
N5	3





TOP VIEW

DESIGN INFORMATION	
SPECIFICATION	VALUE
DIAMETER O.D./I.D.	36 O.D.
MAWP	165 PSI AT 400°F
MDMT	-20°F AT 165 PSI
CAPACITY	APPROX 400 GALLONS
SHIPPING WEIGHT	717 LBS
CRN	L4039.5C

TITLE
VERTICAL AIR RECEIVER

SAMUEL PRESSURE VESSEL GROUP

CUSTOMER
STOCK

TYPE
ASME

DRAWN	CHECKED	DRAWING NO	REV
KAT 9/7/2016	DMM 10/7/2016	A10055	D29
SIZE: B	SHEET 1 OF 1		

REV	DESCRIPTION	BY	DATE
D29	ISSUED		

(BUILT IN ACCORDANCE WITH LATEST EDITION OF SECTION VIII DIV 1 ASME CODE)

Company:	Martin and Libby	Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Tank Anchorage	Date:	9/24/2021
Fastening point:			

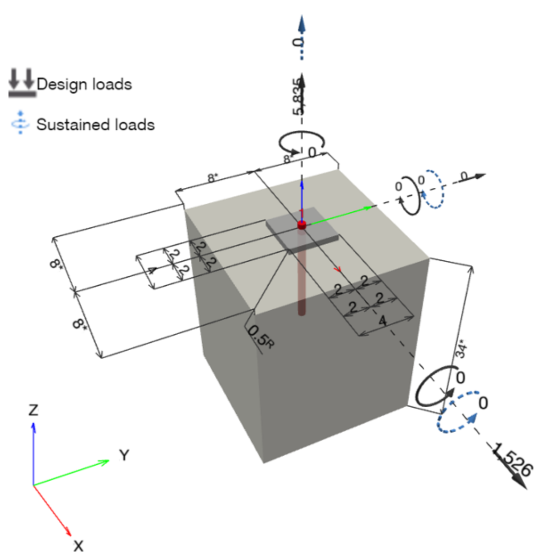
Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 + HAS-R 304/316 SS 5/8**
Item number:	408988 HAS-R 316 SS 5/8"x12" (element) / 2022793 HIT-HY 200-R (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 8.000 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM F 593
Evaluation Service Report:	ESR-3187
Issued I Valid:	5/1/2021 | 3/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate^R :	l_x x l_y x t = 4.000 in. x 4.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 34.000 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

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

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

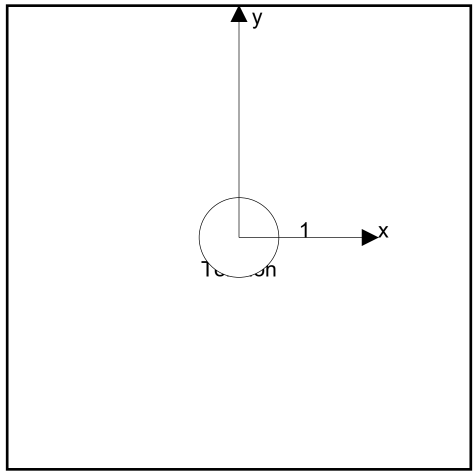


Company:	Martin and Libby	Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Tank Anchorage	Date:	9/24/2021
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 5,835; V_x = 1,526; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	99

2 Load case/Resulting anchor forces



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	5,835	1,526	1,526	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 5,835 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

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

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	5,835	14,690	40	OK
Bond Strength**	5,835	7,013	84	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	5,835	6,456	91	OK

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

Hilti PROFIS Engineering 3.1.1

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-3187

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.23	100,000

Calculations

N_{sa} [lb]
22,600

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
22,600	0.650	1.000	14,690	5,835

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Tank Anchorage	Date:	9/24/2021
Fastening point:			

3.2 Bond Strength

$N_a = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$	ACI 318-19 Eq. (17.6.5.1a)
$\phi\ N_a \geq N_{ua}$	ACI 318-19 Table 17.5.2
A_{Na} see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)	
$A_{Na0} = (2\ c_{Na})^2$	ACI 318-19 Eq. (17.6.5.1.2a)
$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$	ACI 318-19 Eq. (17.6.5.1.2b)
$\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.4.1b)
$\psi_{cp,Na} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.5.1b)
$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \alpha_{N,seis} \cdot \pi \cdot d_a \cdot h_{ef}$	ACI 318-19 Eq. (17.6.5.2.1)

Variables

$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
2,327	0.625	8.000	8.000	1.000	1,226

c_{ac} [in.]	λ_a	$\alpha_{N,seis}$
14.432	1.000	0.990

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
9.049	256.00	327.54	0.965

$\psi_{cp,Na}$	N_{ba} [lb]
1.000	19,070

Results

N_a [lb]	ϕ_{bond}	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_a$ [lb]	N_{ua} [lb]
14,387	0.650	0.750	1.000	7,013	5,835

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Tank Anchorage	Date:	9/24/2021
Fastening point:			

3.3 Concrete Breakout Failure

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

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
5.333	8.000	1.000	14.432	17	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
256.00	256.00	1.000	1.000	13,243

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
13,243	0.650	0.750	1.000	6,456	5,835

Company:	Martin and Libby	Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Nitrogen Tank Anchorage	Date:	9/24/2021
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	1,526	5,695	27	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	1,526	18,540	9	OK
Concrete edge failure in direction x+**	1,526	5,042	31	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-3187

ϕ $V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.23	100,000	0.700

Calculations

$V_{sa,eq}$ [lb]
9,492

Results

$V_{sa,eq}$ [lb]	ϕ steel	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
9,492	0.600	1.000	5,695	1,526

4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cp} = k_{cp}\left[\left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$	ACI 318-19 Eq. (17.7.3.1a)
$\phi\ V_{cp} \geq V_{ua}$	ACI 318-19 Table 17.5.2
A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)	
$A_{Nc0} = 9\ h_{ef}^2$	ACI 318-19 Eq. (17.6.2.1.4)
$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.4.1b)
$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.6.1b)
$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$	ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2	5.333	8.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
14.432	17	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
256.00	256.00	1.000	1.000	13,243

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
26,485	0.700	1.000	1.000	18,540	1,526

4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V} \; \psi_{c,V} \; \psi_{h,V} \; \psi_{parallel,V} \; V_b$	ACI 318-19 Eq. (17.7.2.1a)
$\phi \; V_{cb} \geq V_{ua}$	ACI 318-19 Table 17.5.2
A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)	
$A_{Vc0} = 4.5 \, c_{a1}^2$	ACI 318-19 Eq. (17.7.2.1.3)
$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$	ACI 318-19 Eq. (17.7.2.4.1b)
$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$	ACI 318-19 Eq. (17.7.2.6.1)
$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c} \, c_{a1}^{1.5}$	ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
8.000	8.000	1.000	34.000	5.000

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.625	4,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
192.00	288.00	0.900	1.000	12,004

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \; V_{cb}$ [lb]	V_{ua} [lb]
7,202	0.700	1.000	1.000	5,042	1,526

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.904	0.303	5/3	99	OK

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

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

Equipment Housekeeping Pads

Equipment	Anchors	T	TΩ	V	VΩ
[-]	[-]	[lbs/anchor]	[lbs/anchor]	[lbs total]	[lbs total]
Air Compressor	4	10	245	159	3
Refrigerated Air Dryer	4	5	27	41	82
Air Tank	4	466	1033	241	482
Nitrogen Generator	4	287	776	711	1421
Nitrogen Tank	4	2592	5835	1526	3052

(Shear Connection of Pad)

- Design shear connection between housekeeping pad and existing foundation using skin friction formulas provided in ACI 318. For strength on reinforcing across the interface assume it will not exceed the maximum tensile force that can be developed by the epoxy anchorage or the ratio development length provided/development length.

#3 bar – $\phi T_n = 0.9(60ksi)(0.11in^2) = 5.94$ kips

(l_{dh})#3 = 5.75” with 2” cover all sides

Ratio = $\frac{3"}{5.75"}(5.94k) = 3.1\ kips$ **(Governs)**

OR

#3 Dowel with Hilti HIT-HY 200 epoxy, embed = 7.5” – T_{max} = 3.85 kips

---

#4 bar – $\phi T_n = 0.9(60ksi)(0.2in^2) = 10.8$kips

(l_{dh})#4 = 7.67” with 2” cover all sides

Ratio = $\frac{3"}{7.67"}(10.8k) = 4.22\ kips$ **(Governs)**

OR

#4 Dowel with Hilti HIT-HY 200 epoxy, embed = 9” – T_{max} = 6.2 kips

Hilti PROFIS Engineering 3.1.1

www.hilti.com

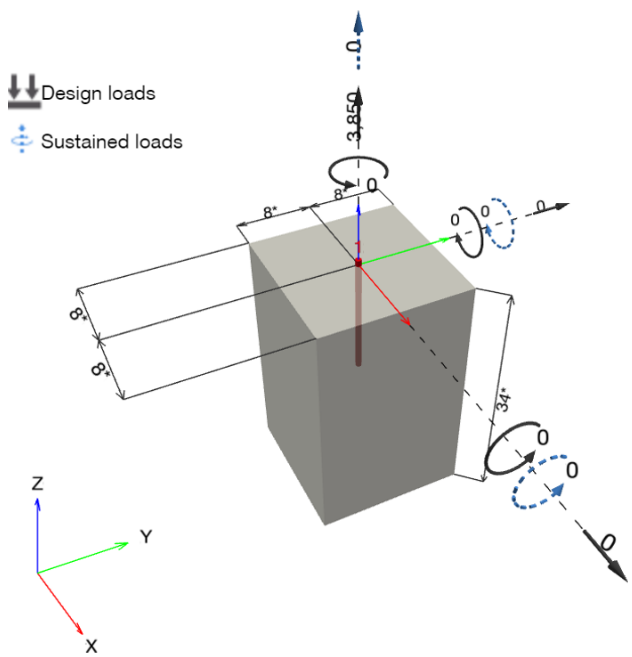
Company:	Martin and Libby	Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 + Rebar A 615 Gr.60 #3**
Item number:	not available (element) / 2022793 HIT-HY 200-R (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 7.500 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM A 615 GR.60
Evaluation Service Report:	ESR-3187
Issued I Valid:	5/1/2021 | 3/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 34.000 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d)) Shear load: yes (17.10.6.3 (c))

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



Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 3,850; V_x = 0; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	99

2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	3,850	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3,850	5,720	68	OK
Bond Strength**	3,850	3,901	99	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	3,850	6,456	60	OK

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

3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-3187

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.11	80,026

Calculations

N_{sa} [lb]
8,800

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
8,800	0.650	5,720	3,850

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

3.2 Bond Strength

N_a	$= \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$	ACI 318-19 Eq. (17.6.5.1a)
$\phi\ N_a$	$\geq N_{ua}$	ACI 318-19 Table 17.5.2
A_{Na}	see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)	
A_{Na0}	$= (2\ c_{Na})^2$	ACI 318-19 Eq. (17.6.5.1.2a)
c_{Na}	$= 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$	ACI 318-19 Eq. (17.6.5.1.2b)
$\psi_{ed,Na}$	$= 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.4.1b)
$\psi_{cp,Na}$	$= \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.5.1b)
N_{ba}	$= \lambda_a \cdot \tau_{k,c} \cdot \alpha_{N,seis} \cdot \pi \cdot d_a \cdot h_{ef}$	ACI 318-19 Eq. (17.6.5.2.1)

Variables

$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
1,636	0.375	7.500	8.000	1.000	1,132

c_{ac} [in.]	λ_a	$\alpha_{N,seis}$
12.047	1.000	0.800

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
4.552	82.89	82.89	1.000

$\psi_{cp,Na}$	N_{ba} [lb]
1.000	8,001

Results

N_a [lb]	ϕ_{bond}	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_a$ [lb]	N_{ua} [lb]
8,001	0.650	0.750	1.000	3,901	3,850

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

3.3 Concrete Breakout Failure

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

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
5.333	8.000	1.000	12.047	17	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
256.00	256.00	1.000	1.000	13,243

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
13,243	0.650	0.750	1.000	6,456	3,850

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (relevant anchors)

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

www.hilti.com

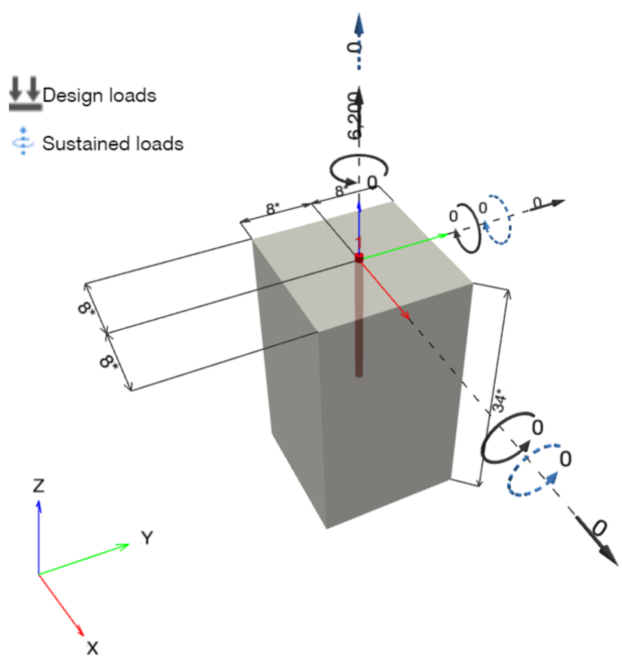
Company:	Martin and Libby	Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 + Rebar A 615 Gr.60 #4**
Item number:	not available (element) / 2022793 HIT-HY 200-R (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 9.000 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM A 615 GR.60
Evaluation Service Report:	ESR-3187
Issued I Valid:	5/1/2021 | 3/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 34.000 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

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



Hilti PROFIS Engineering 3.1.1

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 6,200; V_x = 0; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	100

2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	6,200	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	6,200	10,399	60	OK
Bond Strength**	6,200	6,241	100	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	6,200	6,456	97	OK

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

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-3187

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.20	80,026

Calculations

N_{sa} [lb]
15,999

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
15,999	0.650	10,399	6,200

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

3.2 Bond Strength

$N_a = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na} \psi_{cp,Na} N_{ba}$	ACI 318-19 Eq. (17.6.5.1a)
$\phi N_a \geq N_{ua}$	ACI 318-19 Table 17.5.2
A_{Na} see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)	
$A_{Na0} = (2\ c_{Na})^2$	ACI 318-19 Eq. (17.6.5.1.2a)
$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$	ACI 318-19 Eq. (17.6.5.1.2b)
$\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.4.1b)
$\psi_{cp,Na} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.5.5.1b)
$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \alpha_{N,seis} \cdot \pi \cdot d_a \cdot h_{ef}$	ACI 318-19 Eq. (17.6.5.2.1)

Variables

$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
1,636	0.500	9.000	8.000	1.000	1,132

c_{ac} [in.]	λ_a	$\alpha_{N,seis}$
14.456	1.000	0.800

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
6.069	147.35	147.35	1.000

$\psi_{cp,Na}$	N_{ba} [lb]
1.000	12,802

Results

N_a [lb]	ϕ_{bond}	$\phi_{seismic}$	$\phi_{nonductile}$	ϕN_a [lb]	N_{ua} [lb]
12,802	0.650	0.750	1.000	6,241	6,200

Company:	Martin and Libby	Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

3.3 Concrete Breakout Failure

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N} \; \psi_{c,N} \; \psi_{cp,N} \; N_b$	ACI 318-19 Eq. (17.6.2.1a)
$\phi \; N_{cb} \geq N_{ua}$	ACI 318-19 Table 17.5.2
A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)	
$A_{Nc0} = 9 \; h_{ef}^2$	ACI 318-19 Eq. (17.6.2.1.4)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.4.1b)
$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$	ACI 318-19 Eq. (17.6.2.6.1b)
$N_b = k_c \; \lambda_a \; \sqrt{f_c'} \; h_{ef}^{1.5}$	ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f_c' [psi]
5.333	8.000	1.000	14.456	17	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
256.00	256.00	1.000	1.000	13,243

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \; N_{cb}$ [lb]	N_{ua} [lb]
13,243	0.650	0.750	1.000	6,456	6,200

Hilti PROFIS Engineering 3.1.1

www.hilti.com

Company:	Martin and Libby	Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Epoxy Dowel at Pad	Date:	10/14/2021
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity $\phi\ V_n$ [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (relevant anchors)

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

Equipment Housekeeping Pads Cont.

(Shear Connection of Pad)

Shear Friction – $\phi V_n = A_{vf} f_y ц$

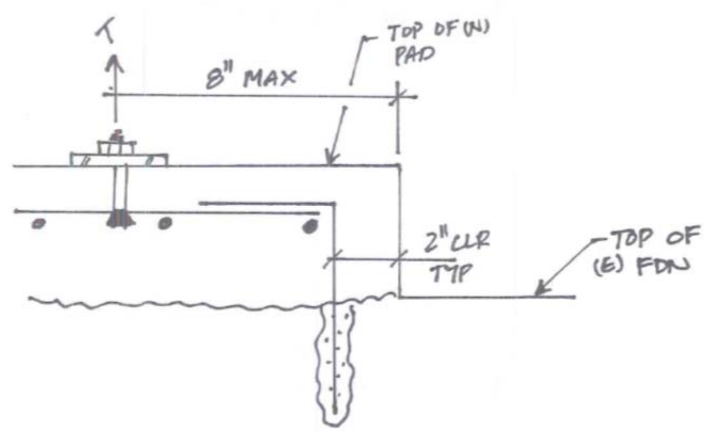
$(\phi V_n)\#3 = (3.56kips)(ц = 1.0) = 3.56k/dowel$

$(\phi V_n)\#4 = (4.84kips)(ц = 1.0) = 4.84k/dowel$

∴ (1) #3 or #4 dowel is adequate to resist all shear from all proposed equipment

(Tension Connection of Pad)

- Check horizontal reinforcing in pad to transfer anchor tension forces to adjacent dowels.
- Note that the embedment for Nitrogen tank epoxy anchors shall start in the existing foundation, therefore, are not applicable in the calculation below.



SECTION

$M_u = (T\Omega = 1033\#)(8" – 2.25") = 5940\#\text{-in}$

$A_s = \#4$ at 12" o.c. = $0.2in^2/ft$, b=12, fy = 60 ksi, f'c = 3000 PSI, d=2.25"

a = 0.40" $\phi M_n = 22140\ \#\text{-in} > M_u$ ∴ **OK**

∴ (1) #4 at 12" o.c. Each Way with 2" clear cover is adequate