

LANE ENGINEERS, INC.

979 N. Blackstone St.
Tulare, CA 93274
Phone: (559) 688-5263
www.laneengineers.com



Date: May 13th, 2022

Sheet: 1 of 6
Job No. 22095

CLIENT: TGO Technologies, Inc.
PROJECT: Tank Restraints for Chlortainer Ton Vessel
LOCATION: 3050 Mill Creek Rd.
Mentone, CA

GOVERNING CODE: California Building Code, 2019 Edition

STRUCTURAL CALCULATIONS ARE BASED ON THE FOLLOWING CRITERIA,
UNLESS NOTED OTHERWISE

Risk Category.....	Risk Category III
Wind Loading	N/A, Indoors
Seismic Loading.....	Design Category D
Structural Steel (shapes, plates, bars).....	ASTM A36 or A572 (36 ksi yield)
Cold-Formed (light-gage) sections, plates, etc.:	
16 Ga. & Heavier	ASTM A653, 50 Class 1 (50 ksi yield)
18 Ga. & Lighter	ASTM A653, Gr. C (33 ksi yield)
Pipe	ASTM A53, Gr. B (35 ksi yield)
Rectangular Hollow Structural Steel.....	ASTM A500, Gr. B (46 ksi yield)
Welding.....	AWS D1.1-10
Bolts	ASTM A307
Concrete Masonry Unit Assembly	f'm = 1,500 psi
Wood Members:	
Studs.....	DF-L No. 2 or better
Joists and Planks	DF-L No. 2 or better
Beams and Stringers	DF-L No. 1 or better
Posts and Timbers	DF-L No. 1 or better
Glulams	24F-V4 (Simple Span) 24F-V8 (Multiple Spans and cantilevers)
Plywood sheathing	APA C-D, Exp. 1, ADA PDS-12
Reinforcing Steel (#4 & smaller)	ASTM A615, Gr. 40
Reinforcing Steel (#5 & larger)	ASTM A615, Gr. 60
Concrete	2,500 psi @ 28 days
Soil Bearing	Assumed, Class 4 soil (SW, SP, SM, SC, GM, GC) per CBC Table 1806.2

LANE ENGINEERS, INC.

979 N. Blackstone ST. • Tulare, California 93274 • (559) 688-5263
www.laneengineers.com

PROJECT VESSEL RESTRAINTS SHEET 2 OF 2
CLIENT TGD JOB NO. 22095
BY JA CHKD BY _____ DATE _____

1. MFRS INFORMATION

WT OF EMPTY TANK = 3000 #

8'-0" OVERALL LENGTH

39 1/4" O.D., 38 1/2" I.D.

S.G. = 1.5

$$V_{TK} = \frac{\pi (3.208)^2 (8')}{4} = 64.66 \text{ ft}^3$$

$$W_{\text{CONTENT}} = 1.5 (64.66 \text{ ft}^3) (62.4 \text{ pcf}) = 6052 \text{ #}$$

$$W_{\text{TOT}} = 3000 + 6052 = 9052 \text{ #}$$

2. LOADING

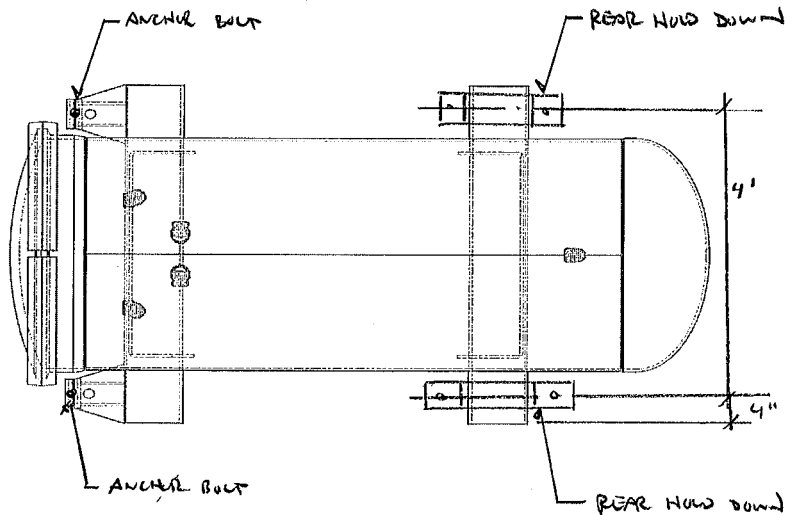
WIND → N/A, INDOORS

$$S_s = 2.336 \rightarrow S_{DS} = 1.869$$

$$S_1 = 0.965 \rightarrow S_{D1} = \text{N/A}$$

$$C_s = \frac{S_{D1} I_e}{R} = \frac{1.869 (1.25)}{3} = 0.779$$

$$V = 0.779 (9052) = 7052 \text{ #}$$



LANE ENGINEERS, INC.

979 North Blackstone Street • Tulare, CA 92374 • 559.688.5263

PROJECT VESSEL RESTRAINTS
 CLIENT TGO
 BY JA CHECKED BY _____

SHEET 3 OF 6
 JOB NO. 22095
 DATE _____

3. STABILITY

$$M_{OT} = 1.0(7052)(39.25"/2) = 138,390 \text{ #}\cdot\text{ft}$$

$$M_R = [0.9 - 0.2(1.869)](9052)(52"/2) = 123842 \text{ #}\cdot\text{ft}$$

$$T = \frac{138,390 - 123842}{52} = 280 \text{ #} \rightarrow T/\text{BOLT} = 280/2 = 140 \text{ #}$$

4. SLIDING

KINETIC FRICTION FACTOR = $\mu_k = 0.3$ (STEEL TO CONCRETE, COND.)

CASE 1: FORCE IN LONGITUDINAL DIRECTION

ALL 6 BOLTS WILL BE ENGAGED (2 AT EACH REAR HOLDDOWN AND 1 AT EACH PIVOT PLATE)

$$V_L = \frac{7052 - 0.3(9052)}{6 \text{ BOLTS}} = 723 \text{ #}$$

CASE 2: FORCE IN TRANSVERSE DIRECTION

4 BOLTS WILL BE ENGAGED [2 AT ONE OF REAR HOLDDOWNS, 1 AT EACH PIVOT PLATE (OPPOSITE REAR HOLD DOWN WILL NOT ENGAGE TANK WHEN FORCE MOVING AWAY FROM TANK)]

$$V_T = \frac{7052 - 0.3(9052)}{4} = 1084 \text{ #}$$

$$T = 140 \text{ #}$$

5. ANCHORAGE

CASE 2 GOVERNS, SEE HILTI ANALYSIS

$$\text{OVERSTRENGTH} \rightarrow T = \frac{2(138390) - 123842}{52} \left(\frac{1}{2}\right) = 1471 \text{ #}$$

$$V = 2(1084) = 2168 \text{ #}$$

AT EACH ANCHOR LOCATION, USE
 1/2" HILTI KWIK BOLT T32
 W/ 3/4" MIN. EMBEDMENT. INSTALL
 PER ICC ESR-4266, SPECIAL
 INJECTION IS REQ'D.

LANE ENGINEERS, INC.

799 North Blackstone Street • Tulare, CA 92374 • 559.688.5263

PROJECT VESSEL RESTRAINTS
 CLIENT TGO
 BY JA CHECKED BY _____

SHEET 4 OF 6
 JOB NO. 22095
 DATE _____

6. REAR HUB DOWN

PRE-MANUFACTURED PLATE BY N.J. MCCUTCHEN

SPT LATERAL WAD IS APPLIED AT 2³/₄" UP FROM CONC. SURFACE (DIM "h")

ANCHOR BOLT LOCATED 1¹/₂" FROM VERT. FACE (DIM "s")

→ JAY ONE SIDE OF PLATE RESISTS FORCE IN CONC. DYN

$$M_{C1} = \frac{V_L (h-t)}{L} = \frac{723 (2.75 - 1.375)}{4} = 429 \text{ #-in}$$

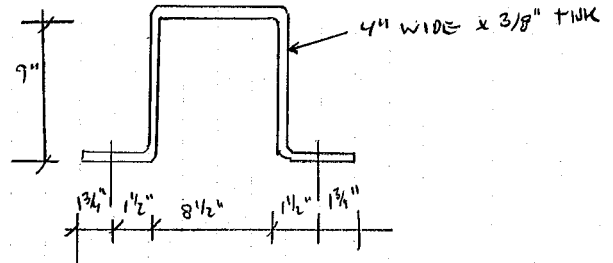
$$t = \sqrt{\frac{6 (429)}{1.35 (30)}} = 0.252 \text{ #}$$

$$M_{C2} = \frac{V_T H}{t} = \frac{1084 (9")}{0.375} = 26016 \text{ #-in}$$

$$L = \sqrt{\frac{6 (26016)}{1.35 (30,000)}} = 1.76" < 4" \text{ #OK}$$

$$M_{R1} = \frac{140 (1.5")}{4} = 52.5 \text{ #-in}$$

$$t_R = \sqrt{\frac{6 (52.5)}{1.35 (30,000)}} = 0.029" \text{ #OK}$$





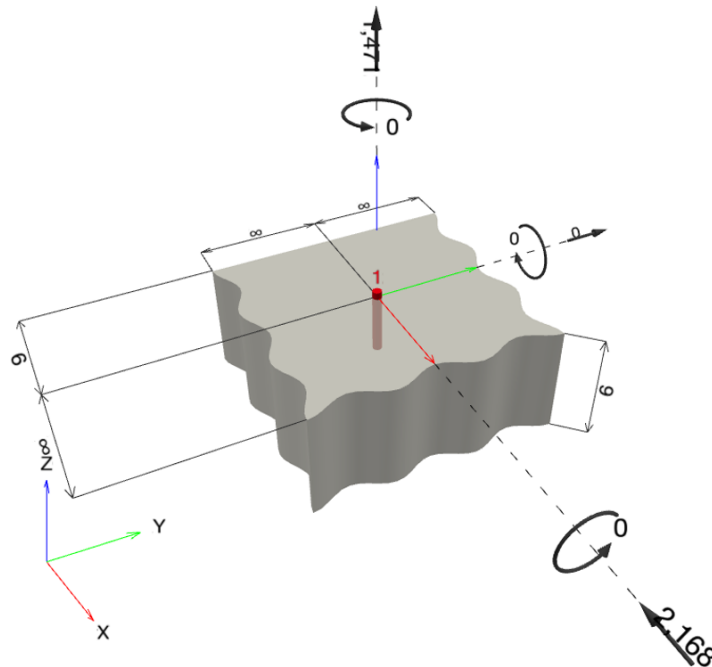
PRE-MANUFACTURED PLATE BY
 N.J. MCCUTCHEN WITHIN ALLOWABLE
 STRESSES


Hilti PROFIS Engineering 3.0.77
www.hilti.com

Company:	Lane Engineers	Page:	1
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	Concrete - May 13, 2022	Date:	5/13/2022
Fastening point:			

Specifier's comments:
1 Input data

Anchor type and diameter:	Kwik Bolt TZ2 - SS 316 1/2 (3 1/4) hnom3	 
Item number:	2210265 KB-TZ2 1/2x4 1/2 SS316	
Effective embedment depth:	$h_{ef,act} = 3.250$ in., $h_{nom} = 3.750$ in.	
Material:	AISI 316	
Evaluation Service Report:	ESR-4266	
Issued Valid:	12/17/2021 12/1/2023	
Proof:	Design Method ACI 318-14 / Mech	
Stand-off installation:		
Profile:		
Base material:	cracked concrete, 3000, $f'_c = 3,000$ psi; $h = 6.000$ in.	
Installation:	hammer drilled hole, Installation condition: Dry	
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present	
	edge reinforcement: none or < No. 4 bar	
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.2.3.4.3 (d))	
	Shear load: yes (17.2.3.5.3 (c))	

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



Hilti PROFIS Engineering 3.0.77
www.hilti.com

Company:	Lane Engineers	Page:	3
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	Concrete - May 13, 2022	Date:	5/13/2022
Fastening point:			

2 Proof I Utilization (Governing Cases)

Loading	Proof	Design values [lb]		Utilization	Status
		Load	Capacity	β_N / β_V [%]	
Tension	Concrete Breakout Failure	1,471	2,660	56 / -	OK
Shear	Concrete edge failure in direction x-	2,168	3,311	- / 66	OK

Loading	β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
Combined tension and shear loads	0.553	0.655	5/3	87	OK

3 Warnings

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

Fastening meets the design criteria!