Structural Calculations

For

Vertical LP Dispenser Tanks
Wisconsin Installations

Prepared for

Manchester Tank
Bedford, Indiana

PACE Project Number 16857

October 25, 2017

Limitations

Engineer was retained in limited capacity for this project. Design is based upon information provided by the client, who is solely responsible for the accuracy of same. No responsibility and/or liability is assumed by, or is to be assigned to the engineer for items beyond that shown on these sheets. ___38___ sheets total including this cover sheet.

WISCONSIN
CHRISTOPHER W. ANDERSON
E-45887
TIGARD
OREGON
PROFESSIONAL ENGINEER

25-OCT-17

RENEWS: 31-JUL-18

This Packet of Calculations is Null and Void if Signature above is not <u>Original</u>

PACE ENGINEERS, Inc.
5000 Meadows Road, Suite 345
Lake Oswego, OR 97035
(503) 597-3222 Fax (503) 597-7655

Foundation and Anchorage Design
For Vertical LP Dispenser Tanks
PACE Job No. 16857

Structural Calculations
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MASTER DATA SHEET & DESCRIPTION

MD1

Project Description:

PACE Job No. 16857

The scope of this project includes evaluating the foundation and anchorage details for 1150 gallon, 1250 gallon, and 1600 gallon Vertical LP Dispenser Tanks installed on crash post assemblies. Analyses of the tanks, base frame, crash post assembly and related connections is outside PACE Engineer's scope of work and shall be performed by a qualified engineer. At the present time, dispenser tanks are anticipated to be installed at one location within the state of Wisconsin as listed below. The structural calculations incorporate higher wind speeds and seismic accelerations to accommodate future installations; however, tanks installed in Seismic Design Category C, D, E, or F regions will require structural calculations for the specific site.

Every installation of a Vertical LP Dispenser Tank needs to be reviewed by a qualified engineer to insure the tank and its foundation do not impact or apply loads to adjacent structures. Additionally, these calculations need to be reviewed each time the authority having jurisdiction approves changes to the local building code, including adopting a newer edition of the local building code.

Location of current installation:

- 835 E Green Bay Ave
  Saukville, WI 53080

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MASTER DATA SHEET & DESCRIPTION

MD2

Project Specifications:

Code:	Wisconsin Administrative Code and Register, Chapter SPS 362 "Buildings and Structures", Based on the 2012 International Building Code ASCE 7-10 Minimum Design Loads for Buildings and Other Structures NFPA 58 – 2017
Risk Category:	III

Wind Design:

Basic Wind Speed	V_{ult}	200 MPH*	ASCE 7-10
Wind Exposure	Category:	D*	
Wind Analysis Procedure	Other Structures		ASCE 7-10

*This value represents a conservative value used for design. For local values, see sheet 3.

Seismic Design:

Spectral Response Coefficient –	S_{DS}:	0.33g**	USGS Hazard Maps
Spectral Response Coefficient –	S_{D1}:	0.133g**	USGS Hazard Maps
Seismic Design Category		B	ASCE 7-10
Importance Factors –	I_P:	1.5	ASCE 7-10
Response Modification Factor –	R_P:	2.0	ASCE 7-10

**This value represents a conservative value used for design. For local values, see sheet 2.

Material Data:

Steel:	All-thread rods	ASTM F1554 GR. 36
Concrete:	Foundations	f'_c = 3000 psi
Reinforcing:	Foundations	ASTM A615
Soils:	Bearing Pressure	750 psf – SPS 362.1806

Structural Analysis Software Used:

Hilti Profis Anchor

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JOB NO. 16857

JOB NAME VERTICAL LP DISPENSER

SHEET NO. 1 OF

CALCULATED BY CA DATE 10/13/16

CHECKED BY DATE

DEAD LOADS:

1150 GAL TANK: SELF-WEIGHT: 2920 #

CONTENTS: (4.25 #/GAL)(1150 GAL) = 4890 #

CRASH POST: (ASSUMED) 390 #

Σ = 8200 #

1250 GAL TANK: SELF-WEIGHT: 3210 #

CONTENTS: (4.25 #/GAL)(1250 GAL) = 5310 #

CRASH POST: 380 #

Σ = 8900 #

1600 GAL TANK: SELF-WEIGHT: 4040 #

CONTENTS: (4.25 #/GAL)(1600 GAL) = 6800 #

CRASH POST: 360 #

Σ = 11,200 #

SEISMIC LOADS:

$V = C_S W$, $C_S = \frac{S_{DS}}{R/I}$, MAX S_{DS} = .081 IN SAUKVILLE

USE S_{DS} = .33 ⇒ SDC B

⇒ Ω DOES NOT APPLY

R = 2.0 ELEVATED TANK ON UNBRACED LEGS.

$C_S = \frac{.33}{2/1.5} = .25$ > MIN $C_S = .044 S_{DS} I$

$= .044(.33)(1.5)$

$= .02$ ✓

V = .25(8200 #) =	2050 #	(1150 GAL)
.25(8900 #) =	2230 #	(1200 GAL)
.25(11,200 #) =	2800 #	(1600 GAL)

USGS Design Maps Summary Report

SHEET: 2

User–Specified Input

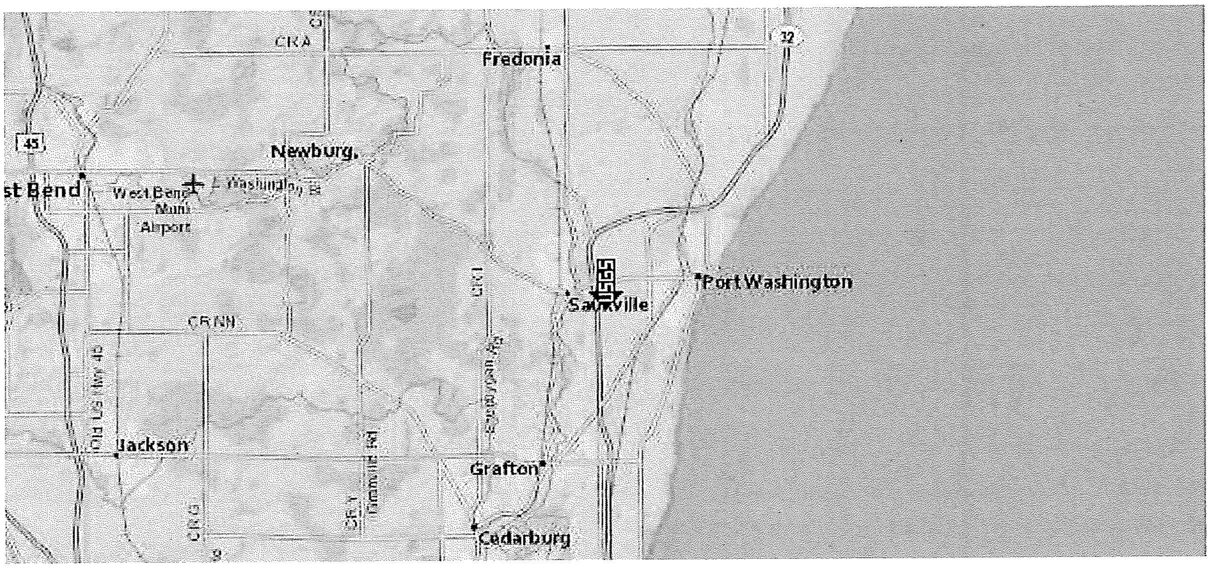
Report Title 835 E Green Bay Ave
Wed October 25, 2017 16:37:29 UTC

Building Code Reference Document ASCE 7-10 Standard
(which utilizes USGS hazard data available in 2008)

Site Coordinates 43.38466°N, 87.92241°W

Site Soil Classification Site Class D – "Stiff Soil"

Risk Category I/II/III

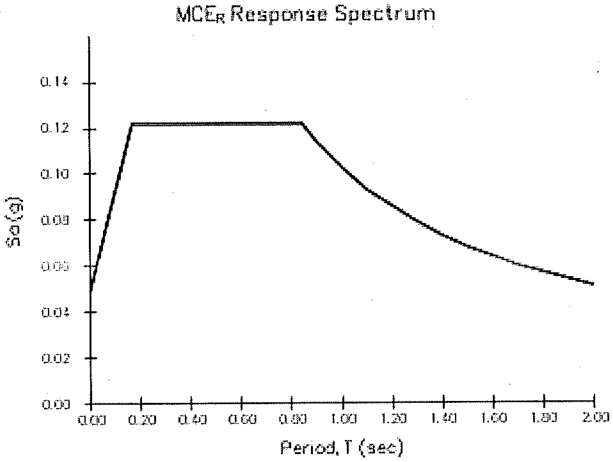


USGS–Provided Output

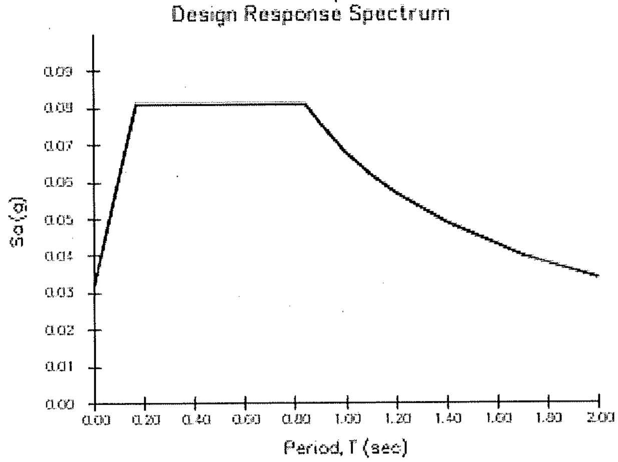
$S_S =$	0.076 g	$S_{MS} =$	0.122 g	$S_{DS} =$	0.081 g
$S_1 =$	0.043 g	$S_{M1} =$	0.103 g	$S_{D1} =$	0.068 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.

MCE$_R$ Response Spectrum



Design Response Spectrum



For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

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JOB NO. 16857
JOB NAME VERTICAL LP DISPENSER
SHEET NO. 3 OF
CALCULATED BY CA DATE 10/13/16
CHECKED BY DATE

WIND LOADS:

$F = q_z G C_f A$ (ASCE 7-10, EQ 29.5-1)

$q_z = .00256 K_z K_{zt} K_d V^2$

$K_z = 1.08$ (h = 20 ft, EXP. D)
$K_{zt} = 1.0$
$K_d = .95$ (ROUND TANK)
$V = 120$ MPH
⇒ USE $V = 200$ MPH

$q_z = .00256(1.08)(1.0)(.95)(200)^2$
$= 105$ PSF

$G = .85$ (RIGID)

$C_f = 0.6$ (MODERATELY SMOOTH, $h/D = 7$, $D\sqrt{q_z} > 2.5$)

$F = (105 \text{ PSF})(.85)(0.6) A$

$= 53.6 A$

TANK	AREA		F
1150 GAL	4'(159"/12)	=	2840 #
1250 GAL	4'(170"/12)	=	3030 #
1600 GAL	4'(218"/12)	=	3890 #

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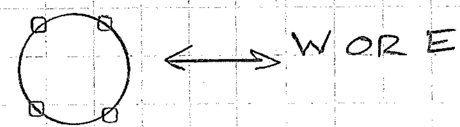
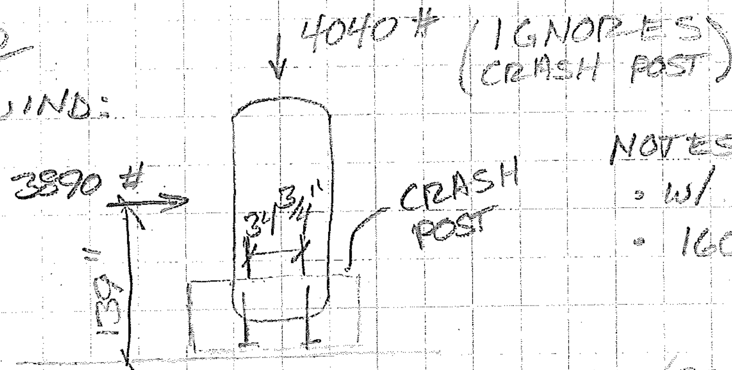
JOB NO. 16857
JOB NAME VERTICAL LP DISPENSER
SHEET NO. 4 OF
CALCULATED BY CA DATE 10/13/16
CHECKED BY DATE

ANCHORAGE:



FBD

WIND:

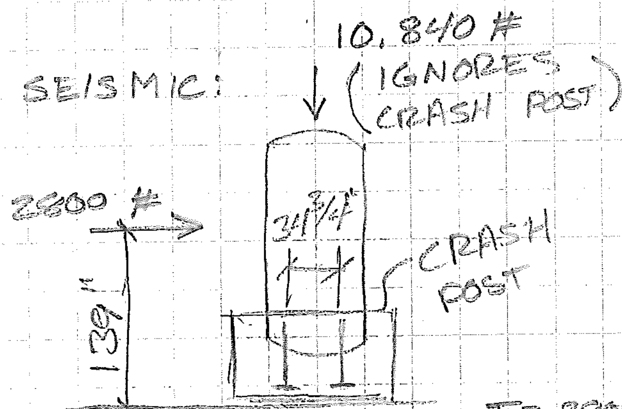


NOTES:
- W/ EMPTY TANK
- 1600 GAL TANK CONTROLS BY OBSERVATION

$$T = \frac{(3890\#)(139") - .9(4040)\left(\frac{34\,3/4"}{2}\right)}{34\,3/4"}$$

$T = 13,740\ \#$

SEISMIC:



NOTES:
- W/ FULL TANK
- 1600 GAL TANK CONTROLS BY OBSERVATION

$$T = \frac{2800\#(139") - [.9 - .2(.33)](10,840\#)\left(\frac{34\,3/4"}{2}\right)}{34\,3/4"}$$

$T = 6680\ \#$

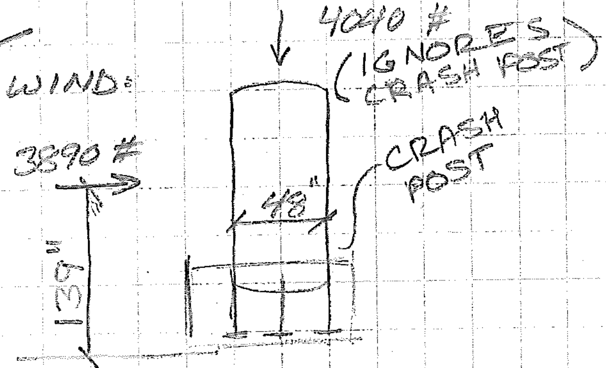
WIND CONTROLS: $V_u = \frac{3890\ \#}{4\ LEGS} = 970\ \#/LEG$

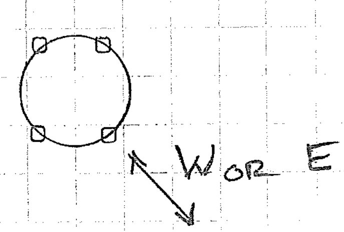
$T_u = \frac{13,740\#}{2\ LEGS} = 6870\ \#/LEG$

ANCHORAGE CONT:

FBD

WIND:



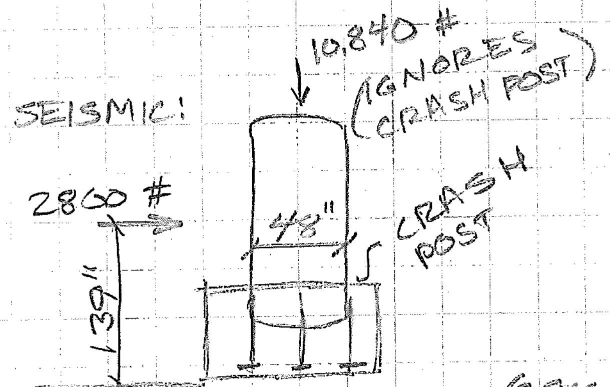


NOTES:
- W/ EMPTY TANK
- 1600 GAL TANK CONTROLS BY OBSERVATION

$$T = \frac{3890\#(139") - .9(4040\#)\left(\frac{48"}{2}\right)}{48"}$$

$T = 9450\ \#$

SEISMIC:



NOTES:
- W/ FULL TANK
- 1600 GAL TANK CONTROLS BY OBSERVATION

$$T = \frac{(2800\#)(139") - [.9 - .2(.33)](10,840\#)\left(\frac{48"}{2}\right)}{48"}$$

$T = 3590\ \#$

$\Rightarrow$ WIND CONTROLS: $V_u = \frac{3890\ \#}{4\ LEGS} = 970\#/LEGS$

$T_u = 9450\ \#/LEG$

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JOB NAME VERTICAL LP DISPENSER
SHEET NO. 6 OF
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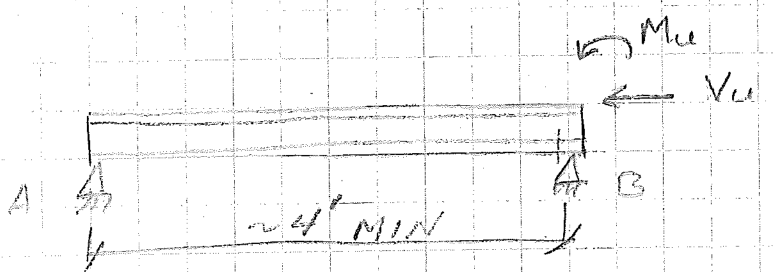
ANCHORAGE CONT:

CRASH POST LOADS: 6 k @ 3'
PER NFPA 58, 2017



$V = 1.6(6\ k) = 9.6\ k$
$M_u = 1.6(6\ k)(3') = 28.8\ k \cdot ft$

@ B: $V_u = \frac{9.6k}{2} = 4.8\ k$

$T_u = \frac{28.8\ k \cdot ft}{4'} = 7.2\ k$

2017 NFPA 58 §6.27.3.13

6.27.3.13 Vehicular barrier protection (VBP) shall be provided for containers serving dispensers where those containers are located within 10 ft (3 m) of a vehicle thoroughfare or parking location in accordance with 6.27.3.13(A) or 6.27.3.13(B).

(A) Concrete filled guard posts shall be constructed of steel not less than 4 in. (100 mm) in diameter with the following characteristics:

(1) Spaced not more than 4 ft (1200 mm) between posts on center
(2) Set not less than 3 ft (900 mm) deep in a concrete footing of not less than 15 in. (380 mm) diameter
(3) Set with the top of the posts not less than 3 ft (900 mm) above ground
(4) Located not less than 3 ft (900 mm) from the protected installation

→ **(B)** Equivalent protection in lieu of guard posts shall be a minimum of 3 ft (900 mm) in height and shall resist a force of 6000 lb (53,375 N) applied 3 ft (900 mm) above the adjacent ground surface.

SHEET: 7

Profis Anchor 2.6.3

www.hilti.us

Company:	PACE Engineers Inc	Page:	1
Specifier:		Project:	LP Dispenser Tanks
Address:	5000 Meadows Rd Suite 345	Sub-Project I Pos. No.:	With Crash Post
Phone I Fax:	503-597-3222 |	Date:	10/14/2016
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 14.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-11 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 12.000 in. x 0.500 in.; (Recommended plate thickness: not calculated
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3000 psi; h = 18.000 in.
Reinforcement:	tension: condition B, shear: condition B;
	edge reinforcement: none or < No. 4 bar

5/8"ϕ ANCHORS FROM INSTALLATION GUIDE

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

LOADS SHOWN ARE FROM IMPACT.

WIND LOADS

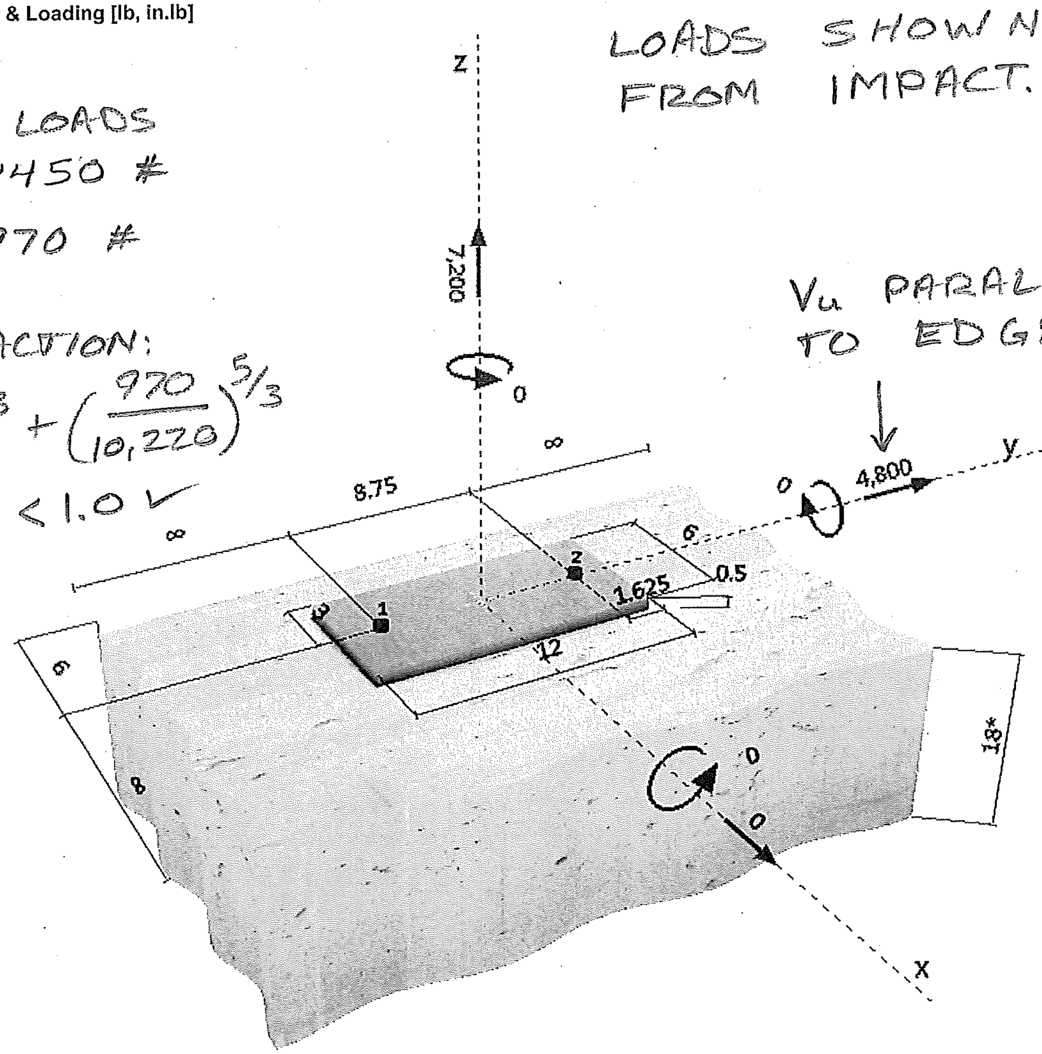
N_u = 9450 #

V_u = 970 #

INTERACTION:

$$\left(\frac{9450}{15{,}250}\right)^{5/3} + \left(\frac{970}{10{,}220}\right)^{5/3} = .47 < 1.0 \checkmark$$

V_u PARALLEL TO EDGE



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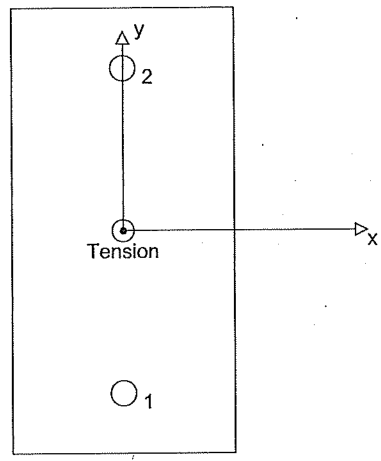
Phone I Fax:	503-597-3222 |	Date:	10/14/2016
E-Mail:			

2 Load case/Resulting anchor forces

Load case: Design loads



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	3600	2400	0	2400
2	3600	2400	0	2400

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 7200 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3600	9831	37	OK
Pullout Strength*	3600	7627	48	OK
Concrete Breakout Strength**	7200	30448	24	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (anchors in tension)

X 2 ANCHORS
= 15,250#

3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-11 Eq. (D-2)
$\phi\, N_{sa} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	3600

3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-11 Eq. (D-13)

$N_p = 8 A_{brg} f'_c$ ACI 318-11 Eq. (D-14)

$\phi N_{pN} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	λ_a	f'_c [psi]
1.000	0.45	1.000	3000

Calculations

N_p [lb]
10896

Results

N_{pn} [lb]	$\phi_{concrete}$	ϕN_{pn} [lb]	N_{ua} [lb]
10896	0.700	7627	3600

3.3 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ ACI 318-11 Eq. (D-4)

$\phi N_{cbg} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

A_{Nc} see ACI 318-11, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9 h_{ef}^2$ ACI 318-11 Eq. (D-5)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-8)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-11 Eq. (D-10)

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-12)

$N_b = 16 \lambda_a \sqrt{f'_c} h_{ef}^{5/3}$ ACI 318-11 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
14.000	0.000	0.000	6.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
-	16	1.000	3000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
1370.25	1764.00	1.000	1.000	0.786	1.000	71268

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
43497	0.700	30448	7200

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E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2400	5112	47	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	4800	60896	8	OK
Concrete edge failure in direction x-**	4800	14048	35	OK

* anchor having the highest loading **anchor group (relevant anchors)

X 2 ANCHORS
= 10,220 #

4.1 Steel Strength

$V_{sa} = 0.6\, A_{se,V}\, f_{uta}$ ACI 318-11 Eq. (D-29)
$\phi\, V_{steel} \geq V_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\, V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	2400

4.2 Pryout Strength

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ec,N}\,\psi_{ed,N}\,\psi_{c,N}\,\psi_{cp,N}\,N_b\right]$ ACI 318-11 Eq. (D-41)
$\phi\, V_{cpg} \geq V_{ua}$ ACI 318-11 Table D.4.1.1
A_{Nc} see ACI 318-11, Part D.5.2.1, Fig. RD.5.2.1(b)
$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-11 Eq. (D-5)
$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-8)
$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-11 Eq. (D-10)
$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-12)
$N_b = 16\, \lambda_a \sqrt{f'_c}\, h_{ef}^{5/3}$ ACI 318-11 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	14.000	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	-	16	1.000	3000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
1370.25	1764.00	1.000	1.000	0.786	1.000	71268

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\, V_{cpg}$ [lb]	V_{ua} [lb]
86994	0.700	60896	4800

4.3 Concrete edge failure in direction x-

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\, \psi_{ed,V}\, \psi_{c,V}\, \psi_{h,V}\, \psi_{parallel,V}\, V_b$ ACI 318-11 Eq. (D-31)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-11 Table D.4.1.1

A_{Vc} see ACI 318-11, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-11 Eq. (D-32)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-36)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-11 Eq. (D-38)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-11 Eq. (D-39)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f_c'}\, c_{a1}^{1.5}$ ACI 318-11 Eq. (D-33)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
6.000	-	0.000	1.000	18.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	3000	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
240.75	162.00	1.000	1.000	1.000	6752

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
20069	0.700	14048	4800

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.472	0.469	5/3	57	OK

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

6 Warnings

- Load re-distributions 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 loading! Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening meets the design criteria!

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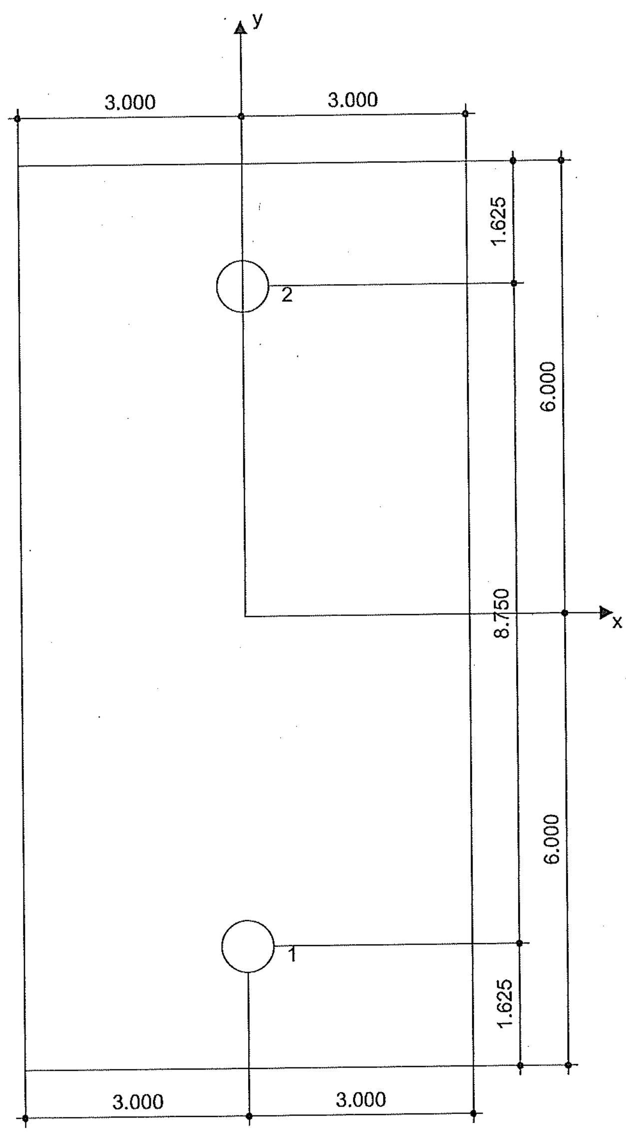
7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -
Hole diameter in the base material: - in.
Hole depth in the base material: 14.000 in.
Minimum thickness of the base material: 14.922 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	-4.375	6.000	-	-	-
2	0.000	4.375	6.000	-	-	-

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E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 14.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-11 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 12.000 in. x 0.500 in.; (Recommended plate thickness: not calculated
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3000 psi; h = 18.000 in.
Reinforcement:	tension: condition B, shear: condition B;
	edge reinforcement: none or < No. 4 bar

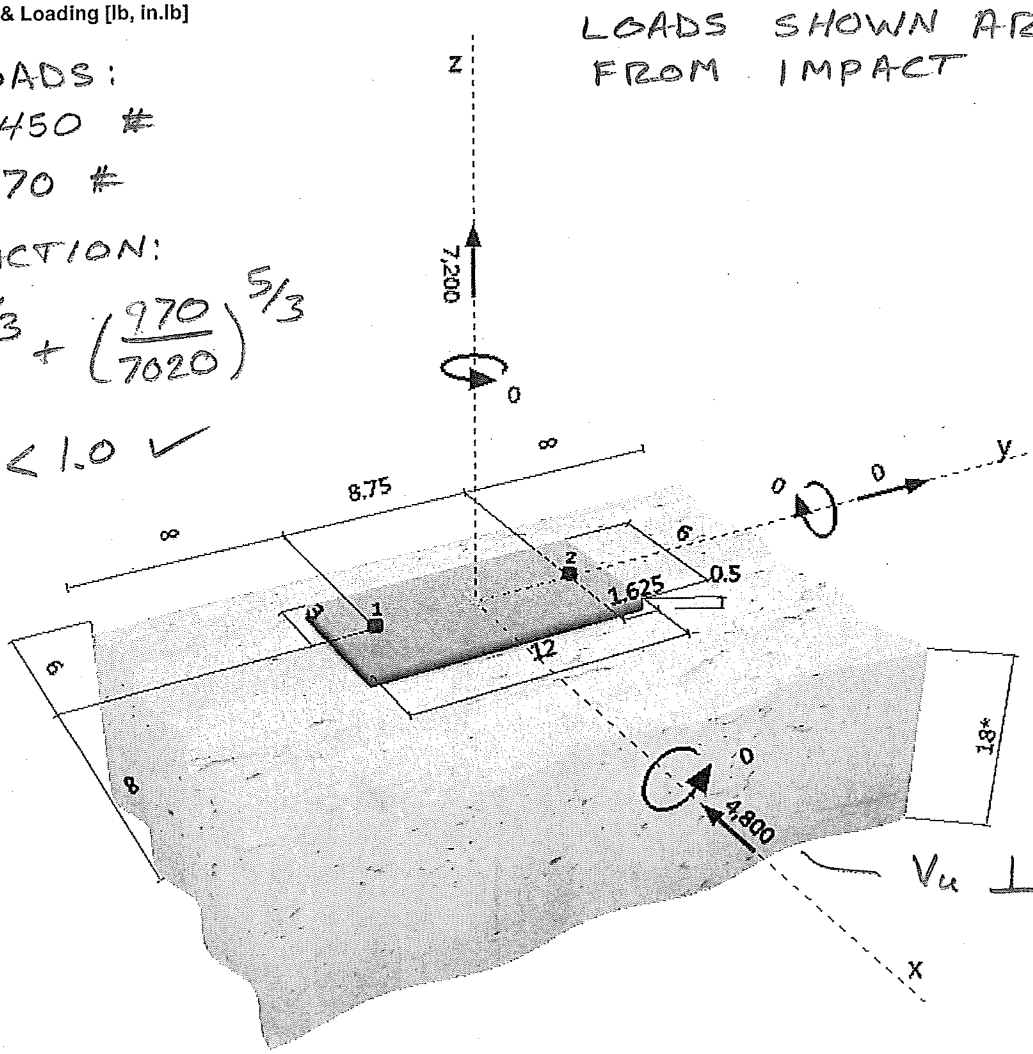
5/8"ϕ ANCHORS FROM INSTALLATION GUIDE

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

LOADS SHOWN ARE FROM IMPACT

WIND LOADS:
N_u = 9450 #
V_u = 970 #
INTERACTION:

$$\left(\frac{9450}{15{,}250}\right)^{5/3} + \left(\frac{970}{7020}\right)^{5/3} = .49 < 1.0 \checkmark$$



$V_u \perp$ TO EDGE

SHEET 15

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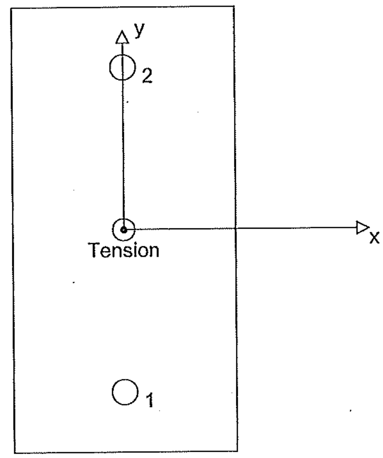
2 Load case/Resulting anchor forces



Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	3600	2400	-2400	0
2	3600	2400	-2400	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 7200 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3600	9831	37	OK
Pullout Strength*	3600	7627	48	OK
Concrete Breakout Strength**	7200	30448	24	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

* anchor having the highest loading . **anchor group (anchors in tension)

X 2 ANCHORS = 15,250 #

3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-11 Eq. (D-2)

$\phi\, N_{sa} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	3600

3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-11 Eq. (D-13)

$N_p = 8 A_{brg} f'_c$ ACI 318-11 Eq. (D-14)

$\phi N_{pN} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	λ_a	f'_c [psi]
1.000	0.45	1.000	3000

Calculations

N_p [lb]
10896

Results

N_{pn} [lb]	$\phi_{concrete}$	ϕN_{pn} [lb]	N_{ua} [lb]
10896	0.700	7627	3600

3.3 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ ACI 318-11 Eq. (D-4)

$\phi N_{cbg} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

A_{Nc} see ACI 318-11, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9 h_{ef}^2$ ACI 318-11 Eq. (D-5)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-8)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-11 Eq. (D-10)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-12)

$N_b = 16 \lambda_a \sqrt{f'_c} h_{ef}^{5/3}$ ACI 318-11 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
14.000	0.000	0.000	6.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
-	16	1.000	3000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
1370.25	1764.00	1.000	1.000	0.786	1.000	71268

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
43497	0.700	30448	7200

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2400	5112	47	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	4800	60896	8	OK
Concrete edge failure in direction x-**	4800	7024	69	OK

* anchor having the highest loading **anchor group (relevant anchors)

X 2 ANCHORS = 10,220 #

7020 # < 10,220 #

4.1 Steel Strength

$V_{sa} = 0.6\, A_{se,V}\, f_{uta}$ ACI 318-11 Eq. (D-29)

$\phi\, V_{steel} \geq V_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\, V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	2400

4.2 Pryout Strength

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ec,N}\,\psi_{ed,N}\,\psi_{c,N}\,\psi_{cp,N}\,N_b\right]$ ACI 318-11 Eq. (D-41)

$\phi\, V_{cpg} \geq V_{ua}$ ACI 318-11 Table D.4.1.1

A_{Nc} see ACI 318-11, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-11 Eq. (D-5)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\,e_N}{3\,h_{ef}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-8)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-11 Eq. (D-10)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-12)

$N_b = 16\, \lambda_a \sqrt{f'_c}\, h_{ef}^{5/3}$ ACI 318-11 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	14.000	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	-	16	1.000	3000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
1370.25	1764.00	1.000	1.000	0.786	1.000	71268

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\, V_{cpg}$ [lb]	V_{ua} [lb]
86994	0.700	60896	4800

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4.3 Concrete edge failure in direction x-

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-11 Eq. (D-31)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-11 Table D.4.1.1

A_{Vc} see ACI 318-11, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-11 Eq. (D-32)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-36)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-11 Eq. (D-38)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-11 Eq. (D-39)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right)\lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-11 Eq. (D-33)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
6.000	-	0.000	1.000	18.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	3000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
240.75	162.00	1.000	1.000	1.000	6752

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
10034	0.700	7024	4800

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.472	0.683	5/3	82	OK

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

6 Warnings

- Load re-distributions 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 loading! Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening meets the design criteria!

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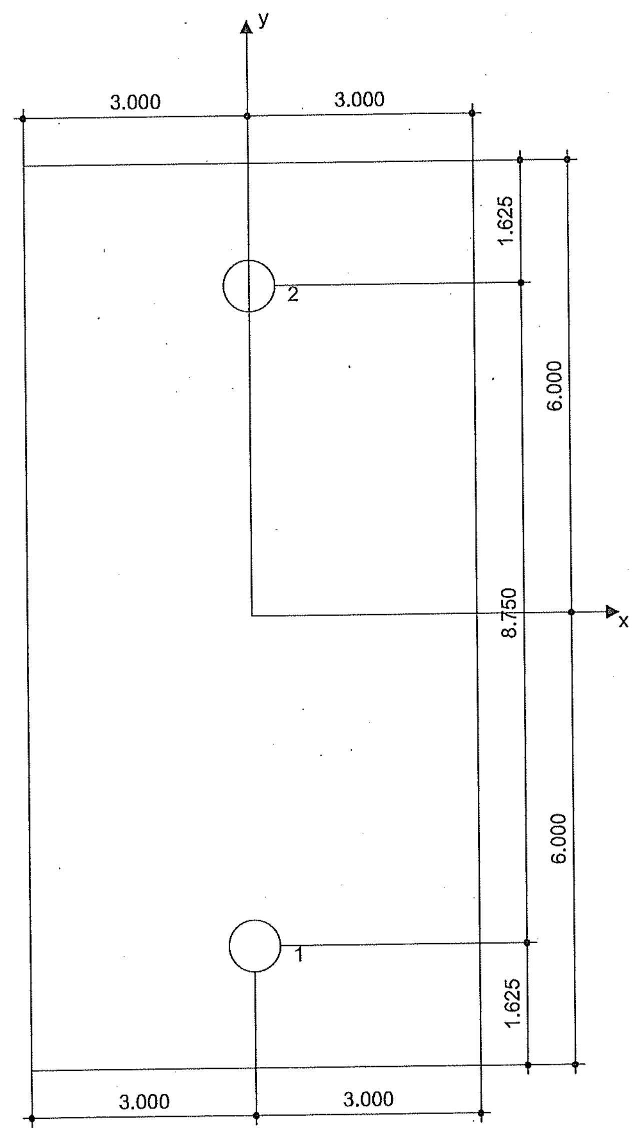
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -
Hole diameter in the base material: - in.
Hole depth in the base material: 14.000 in.
Minimum thickness of the base material: 14.922 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	-4.375	6.000	-	-	-
2	0.000	4.375	6.000	-	-	-

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JOB NO. 116857
JOB NAME VERTICAL LP DISPENSER
SHEET NO. 21 OF
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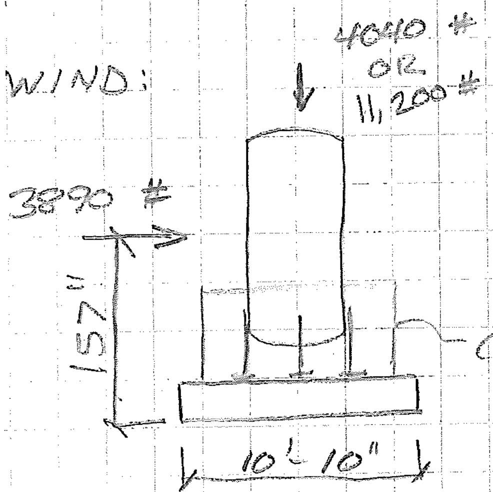
CHECKED BY DATE

SOIL BEARING:

WIND:



FDN WEIGHT:
(150 PCF)(1'-6")(10'-10")(10'-10") = 26,410 #

.6D + .6W

KERN: $e = \frac{M}{P} = \frac{0.6(3890\#)\left(\frac{157"}{12}\right)}{.6(4040 + 26,410)} = 1.67'$ INSIDE KERN

$q_{MAX} = P/A + M/S = \frac{.6(4040 + 26410)}{(10'-10")^2} + \frac{.6(3890\#)\left(\frac{157"}{12}\right)}{\frac{(10'-10")(10'-10")^2}{6}}$

$q_{MAX} = 300$ PSF < 750 PSF
W/ EMPTY TANK

-OR-

D + .6W

$q_{MAX} = \frac{11,200 + 26,410}{(10'-10")^2} + \frac{.6(3890\#)\left(\frac{157"}{12}\right)}{\frac{(10'-10")(10'-10")^2}{6}}$

$q_{MAX} = 460$ PSF < 750 PSF
W/ FULL TANK

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JOB NO. 16857

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SHEET NO. 22 OF

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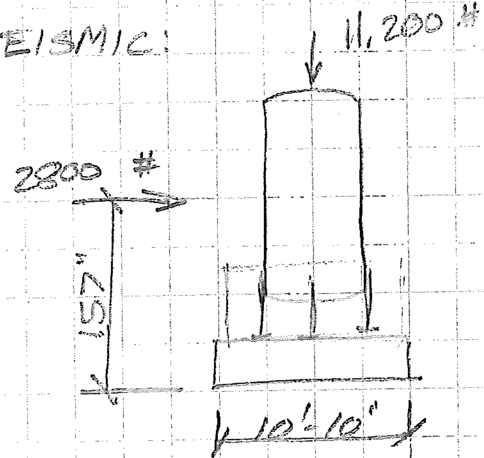
SOIL BEARING CONT:

SEISMIC:



.6D + .7E

KERN: $e = \frac{M}{P} = \frac{.7(2800\#)(\frac{157"}{12})}{.6(11{,}200 + 26{,}410)} = 1.13'$ INSIDE KERN

$q_{MAX} = P/A + M/S = \frac{.6(11{,}200 + 26{,}410)}{(10'\text{-}10")(10'\text{-}10")} + \frac{.7(2800)(\frac{157}{12})}{\frac{(10'\text{-}10")(10'\text{-}10")^2}{6}}$

$q_{MAX} = 310$ PSF < 750 PSF

-OR-

D + .7E

$q_{MAX} = \frac{[1 + .2(.33)](11{,}200 + 26{,}410)}{(10'\text{-}10")(10'\text{-}10")} + \frac{.7(2800\#)(\frac{157"}{12})}{\frac{(10'\text{-}10")(10'\text{-}10")^2}{6}}$

$q_{MAX} = 460$ PSF < 750 PSF

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SLIDING:

FOR COHESIVE SOILS: C = 130 PSF
FOR SAND/CLAYEY SAND: μ = .25

V = .6(3890#) = 2330 # (WIND)
= .7 (2800 #) = 1960 # (SEISMIC)

V_{RES} = (10'-10")(10'-10")(130 PSF) = 15,260 #

-OR-

V_{RES} = .25(4040# + 26,410#) = 7610 #

FACTOR OF SAFETY: $\frac{7610\#}{2330\#}$ = 3.26 > 1.5 ✓

STABILITY:

M_{OT} = .6(3890#)($\frac{157"}{12}$) = 30,540 #·ft

M_R = (4040# + 26,410#)($\frac{10'-10"}{2}$) = 164,920 #·ft

FACTOR OF SAFETY: $\frac{164,920}{30,540}$ = 5.4 > 1.5 ✓

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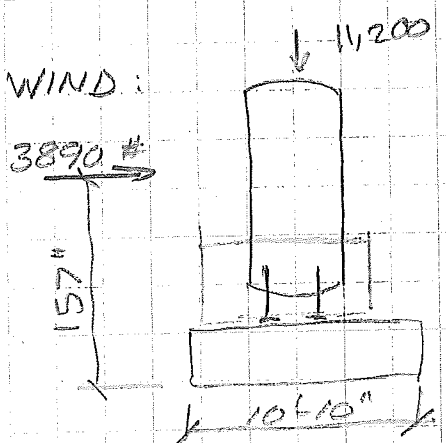
FDN DESIGN:

WIND:



1.2D + 1.0W

$$\text{KERN: } e = \frac{M}{P} = \frac{(3890\#)\left(\frac{157''}{12}\right)}{1.2(11{,}200 + 26{,}410)} = 1.13'$$

⇒ INSIDE KERN

$$q_u = \frac{P}{A} + \frac{M}{S}$$

$$= \frac{1.2(11{,}200 + 26{,}410)}{(10'-10'')(10'-10'')} + \frac{(3890\#)\left(\frac{157''}{12}\right)}{\frac{(10'-10'')(10'-10'')^2}{6}}$$

q_u = 625 PSF WIND

SEISMIC:

1.2D + 1.0E

$$\text{KERN: } e = \frac{M}{P} = \frac{2800\#\left(\frac{157''}{12}\right)}{(1.2 + .2(.33))(11{,}200 + 26{,}410)}$$

$$e = .77' < \frac{10'-10''}{6} = 1.81'$$ INSIDE KERN

$$q_u = \frac{P}{A} + \frac{M}{S} = \frac{[1.2 + .2(.33)][11{,}200 + 26{,}410]}{(10'-10'')(10'-10'')} + \frac{2800\#\left(\frac{157''}{12}\right)}{\frac{(10'-10'')(10'-10'')^2}{6}}$$

q_u = 580 PSF SEISMIC

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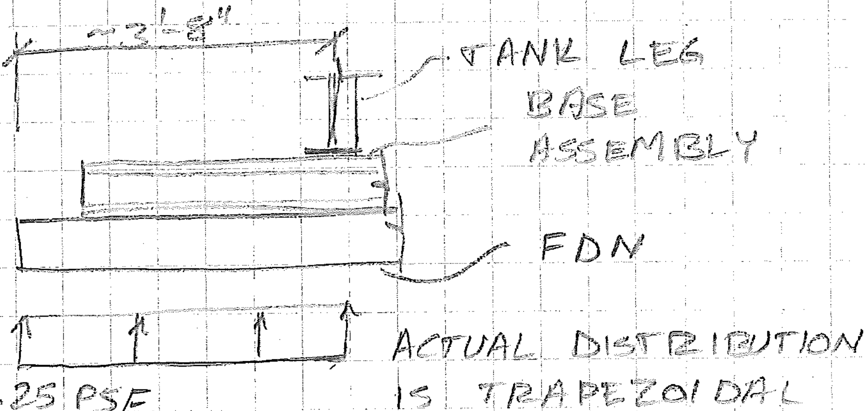
FDN DESIGN CONT:

ONE-WAY SHEAR:

$q_u = 625$ PSF



$V_u = (625 PSF)(3'-8")(1'-0")(\frac{1}{1000})$

$V_u = 2.3$ k

$\phi V_n = \phi 2 \sqrt{f'_c}\, b_w d = .75(2)\sqrt{3000}(12")(14")(\frac{1}{1000})$

$\phi V_n = 13.8$ k > 2.3 k ✓

FLEXURE:

$M_u = (625 PSF)(1'-0")(3'-8")(\frac{3'-8"}{2})(\frac{1}{1000})$

$M_u = 4.2$ k-ft/ft

w/ #5 @ 12" o/c , $T = A_s f_y = (.31 in^2)(60 ksi) = 18.6$ k

$a = \frac{T}{.85 f'_c b} = \frac{18.6}{.85(3)(12)} = .61"$

$\phi M_n = \phi T(d - a/2) = .9(18.6k)(14" - \frac{.61"}{2})(\frac{1}{12})$

$\phi M_n = 19.1$ k-ft > 4.2 k-ft ✓

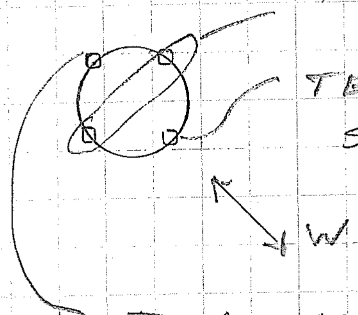
PACE
An Engineering Services Company

www.paceengrs.com

JOB NO. 16857
JOB NAME VERTICAL LP DISPENSER
SHEET NO. 26 OF
CALCULATED BY CA DATE 10/14/16
CHECKED BY DATE

FDN DESIGN CONT:

TWO-WAY SHEAR:



IGNORE COMPRESSION IN THESE LEGS

(WIND) (SEISMIC)

TENSION = 9450 # OR 3590 #

SEE ANCHORAGE CALCS

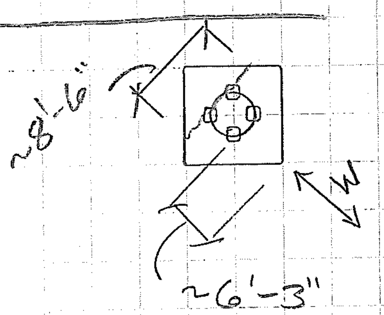
TOTAL COMPRESSION = 9450 + 4040 = 13,490 #

-OR- = 3590 + 11,200 = 14,790 #

$\phi V_n = \phi 4\sqrt{f'_c}\, b_o d$ $b_o = (6" + 14")(4 \text{ SIDES}) = 80"$ (d)

$= .75(4)\sqrt{3000}(80")(14")\left(\frac{1}{1000}\right)$

$\phi V_n = 184.0\text{K} > 14.8\text{K}$ ✓



FDN PROPERTIES: $A = (10'\text{-}10")(10'\text{-}10") = 117 \text{ ft}^2$

$S = \frac{d^3}{6\sqrt{2}} = \frac{(10'\text{-}10")^3}{6\sqrt{2}} = 149.8 \text{ ft}^3$

SOIL PRESSURE:

$q_u = P/A + M/S = \frac{1.2(37{,}610\#)}{117 \text{ ft}^2} + \frac{3890\#\left(\frac{152"}{12}\right)}{149.8 \text{ ft}^3}$

$q_u = 725 \text{ PSF}$

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JOB NO. 16857
JOB NAME VERTICAL LP DISPENSER
SHEET NO. 27 OF
CALCULATED BY CA DATE 10/14/16
CHECKED BY DATE

FDN DESIGN CONT:

ONE WAY SHEAR: (725 PSF)(6'-3") = 4.5K < 138K ✓

TWO WAY SHEAR: OK BY OBSERVATION

FLEXURE: $M_u = (725\ PSF)(6'\text{-}3")\left(\frac{6'\text{-}3"}{2}\right)\left(\frac{1}{1000}\right) = 14.2\ k\cdot ft/ft$

$T = A_s f_y$ w/ #5 @ 45° EA WAY, $A_s = \frac{.31}{\sqrt{2}}(2) = .44\ in^2/ft$

$= .44(60\ ksi)$

$= 26.3\ k$

$a = \frac{T}{.85 f'_c b} = \frac{26.3\ k}{.85(3)(12")} = .86"$

$c = \frac{a}{\beta} = \frac{.86}{.85} = 1.01"$, $c/d = \frac{1.01"}{14"} = .07 < .375$ ✓

$\Rightarrow \phi = 0.9$

$f_s = f_y$

$\phi M_n = T(d - a/2)$

$= .9(26.3\ k)\left(14" - \frac{.86"}{2}\right)\left(\frac{1}{12}\right)$

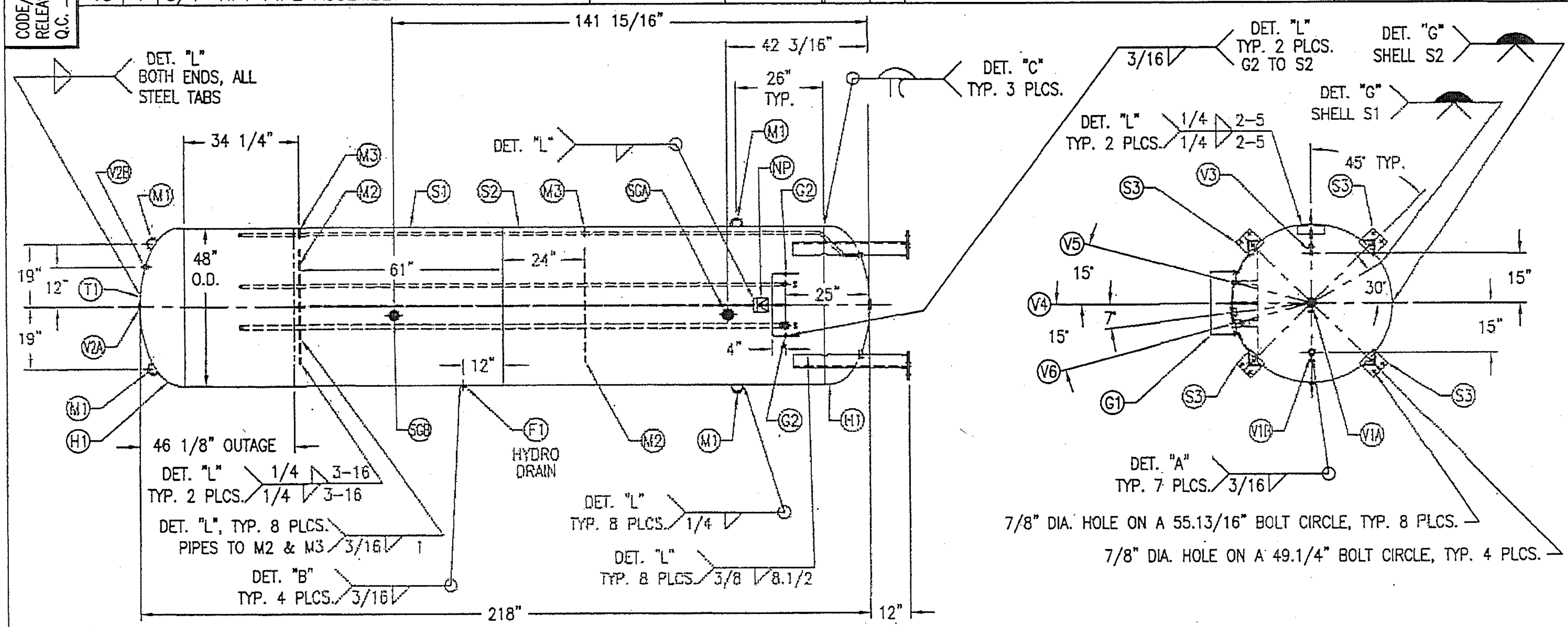
$\phi M_n = 26.8\ k\cdot ft > 14.2\ k\cdot ft$ ✓

SHEET: 28

CODE/ADDENDA
RELEASED FOR PRODUCTION
APPROVED
DATE
Q.C.

NO.	QTY.	DESCRIPTION	SPEC	SUB-DWG.
S1	1	.375 MIN. X 96" X 150" SHELL	SA-516-70	
S2	1	.375 MIN. X 95.5" X 150" SHELL	SA-516-70	
H1	2	.342 MIN. X 48" O.D. 2:1 ELLIP. HEAD	SA-516-70	
F1	1	1" NPT 1500# RADIAL FLANGE	SA-181-70	
V1A	1	2" NPT 1500# FLAT FLANGE	SA-181-70	
V1B	1	1 1/4" NPT 3000# HALF COUPLING	SA-105	
V2A	1	1 1/4" NPT 1500# FLAT FLANGE	SA-181-70	
V2B	1	3/4" NPT 3000# TOE COUPLING	SA-105	
V3	1	3/4" NPT PIPE ASSEMBLY		A59106
V4	1	1/4" NPT PIPE ASSEMBLY		A54419
V5	1	3/4" NPT PIPE ASSEMBLY		A54420

NO.	QTY.	DESCRIPTION	SPEC	SUB-DWG.
V6	1	1 1/4" NPT PIPE ASSEMBLY		A54421
SGA	1	ADAPTOR: S.G. REC. JR	SA-181-70	
SGB	1	ADAPTOR: S.G. NON-REC. SENIOR	SA-181-70	
M1	4	5/8" O.D. LIFT LUG	C1010	A57563
M2	2	PIPE BRACKET: 1/4" X 7 1/2" X 34"	C1010	A77662
M3	2	PIPE BRACKET: 1/4" X 2 3/4" X 8"	C1010	A91875
G1	1	GUARD: 3/16" X 8" X 8" X 18 3/4"	C1010	A53791
G2	2	GUARD CLIP	C1010	A54793
S3	4	ANGLE LEG ASY: 1/2" X 4" X 4" X 34 75"	C1010	A72900
T1	1	TOP TAB	C1010	V12510
NP	1	ASME DATA PLATE	C1010	A77447



NOTES CON'T:
4. BEFORE SHIPPING :
B) INSTALL A85180 SHIPPNG COVER ON SR SG ADAPTER W/ A85182 BOLTS.
C) INSTALL STEEL PLUGS IN ALL OPENINGS.
D) ATTACH SHIPPING BRACE A55742.

SYM	DATE	BY	REVISION	APP	XREF REV.
D	05-96	SE	REV'D X-RAY SPEC., RMV'D X-RAY NOTE, .388 SH WAS .375	JD	
20	07-96	LB	ADDED NOTE #4, DET.'G' WAS DET.'E', ADDED TACK WELD DTL	AS	
21	03-02	LB	REV'D NOTE #4	AS	
E	02-05	EGB	FORMAT UPDATED, RMV'D NOTE 5, REV'D LEG WELDS, ADDED M3 PIPE BRACES, REV'D PIPES, WT WAS 4246#	EGB	
F	8-06	AW	SHELL MATERIAL WAS .387 SA-455, TEMP. WAS 650°F	AW	

NOTES
1. KEEP SIGHT GAUGES IN VERTICAL ALIGNMENT.
2. ALL VALVES AND GAUGES TO BE BOXED AND LABELED, THEN STRAPPED TO SHIPPING BRACE.
3. AIR TEST ALL LINES INTO VAPOR SPACE BEFORE HEAD-UP, AFTER ALL WELDING ON INSIDE OF TANK IS COMPLETED.
4. BEFORE SHIPPING :
A) INSTALL A85179 SHIPPNG COVER ON JR SG ADAPTER W/ A85181 BOLTS.

SPECIFICATIONS

O.D. 48	LGTH. 218	SH. .375	MAT'L.SA-516-70
MAWP 250	PSI @ 450 °F	HD. .342	MAT'L.SA-516-70
RT-4	MDMT -20°F@ 250 PSI	GAL. 1600	S.A.236
EXMT UG20(f)	TEST 325 PSI	WT. 4039#	CU.FT. 213.9
XRAY SPOT	W	CORR ALW —— SH —— HD	
CRN N/A		CODE: ASME SEC. VIII DIV. 1	
WELD DETAILS: M-1932		LATEST EDITION & ADDENDA	

STD. TOLERANCES (UNLESS OTHERWISE NOTED): M-2461

MANCHESTER TANK
H:\2000\

VERTICAL LP DISPENSER
1600 GAL W.C.

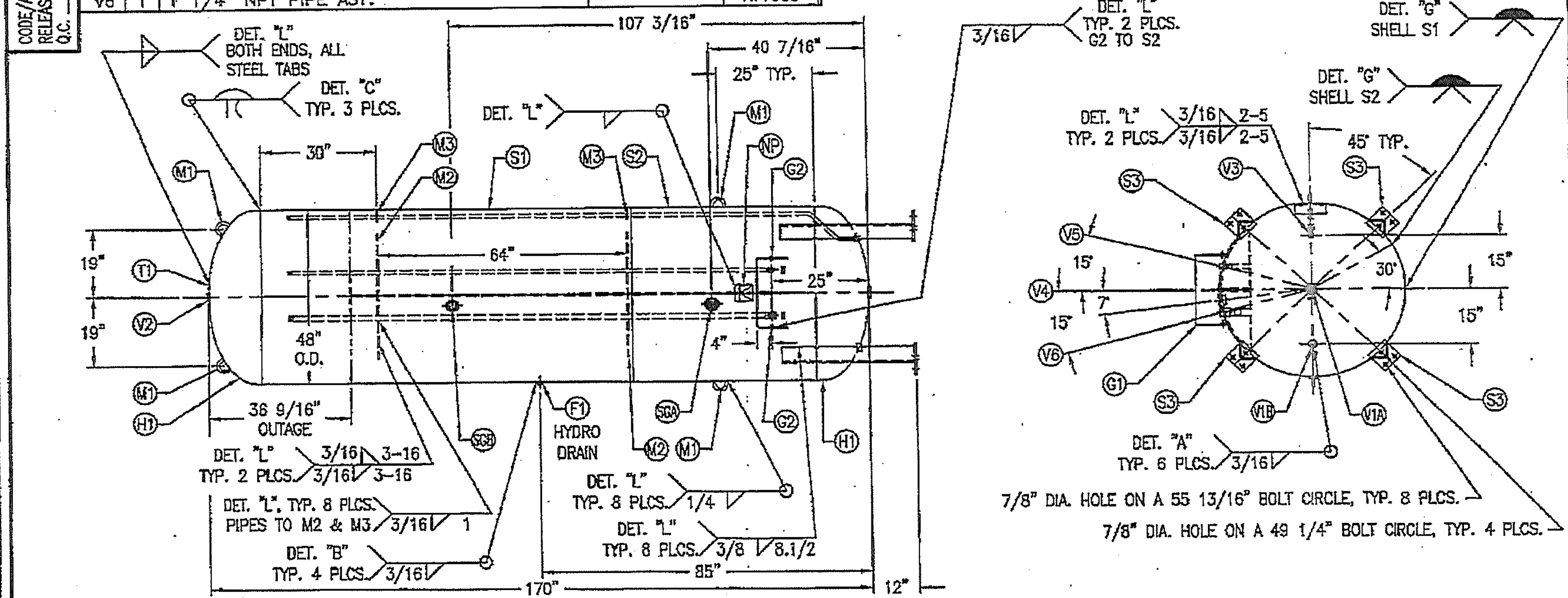
DRAWN BY	DATE	SCALE: NONE
SE	02-07-96	DRAWING NO.
APP. BY JS	DATE 02-27-96	29016

SHEET: 29

NO.	QTY.	DESCRIPTION	SPEC	SUB-DWG.
S1	1	.356 MIN. X 96" X 149 3/4" SHELL	SA-455	
S2	1	.356 MIN. X 48 1/4" X 149 3/4" SHELL	SA-455	
H1	2	.301 MIN. X 48" O.D. 2:1 ELLIP. HEAD	SA-516-70	
F1	1	1" NPT 1500# FLAT FLANGE	SA-181-70	
V1A	1	1 1/4" NPT 1500# FLAT FLANGE	SA-181-70	
V1B	1	1 1/4" NPT 3000# HALF COUPLING	SA-105	
V2	1	1 1/4" NPT 1500# FLAT FLANGE	SA-181-70	
V3	1	3/4" NPT PIPE ASY.		A78001
V4	1	1/4" NPT PIPE ASY.		A78002
V5	1	3/4" NPT PIPE ASY.		A77990
V6	1	1 1/4" NPT PIPE ASY.		A77988

NO.	QTY.	DESCRIPTION	SPEC	SUB-DWG.
SGA	1	ADAPTOR: S.G. REC. JR	SA-181-70	
SGB	1	ADAPTOR: S.G. NON-REC. SENIOR	SA-181-70	
M1	4	5/8" O.D. LIFT LUG		A57563
M2	2	PIPE BRACKET: 1/4" X 7 1/2" X 34"		A77662
M3	2	PIPE BRACKET: 1/4" X 2 3/4" X 8"		A91875
G1	1	GUARD: 3/16" X 8" X 8" X 18 3/4"		A53791
G2	2	GUARD CLIP		A54793
S3	4	ANGLE LEG ASY: 3/8" X 4" X 4" X 34 1/2"		A77993
T1	1	TOP TAB		V12510
NP	1	ASME DATA PLATE		A77447

CODE/ADDENDA
RELEASED FOR PRODUCTION
APPROVED
Q.C. DATE



NOTES CON'T:
4. BEFORE SHIPPING :
B) INSTALL A85180 SHIPPNG COVER ON SR SG ADAPTER W/ A85182 BOLTS.
C) INSTALL STEEL PLUGS IN ALL OPENINGS.
D) ATTACH SHIPPING BRACE A55742.

SYM	DATE	BY	REVISION	APP	XREF REV.
12	07-98	AS	.387 WAS .388 SHELL	AS	
13	03-02	LB	REV'D NOTE #4, ADDED NOTE #5	AS	
C	02-05	EGB	FORMAT UPDATED, ADDED M3, REV'D LEG WELD, RMV'D NOTE #5, TEST PRESSURE WAS 375PSI, PIPES REV'D, WT WAS 3389#	EGB	
D	05-05	JPR	DIM. FOR M2 & M3 WAS 25 1/4"	JLR	
E	8-06	AW	SHELL MATERIAL WAS .387 SA-455, TEMP. WAS 650°F	AW	
F	7/18/13	RB	CHANGED LONGSEAM WELD SYMBOLS TO SHOW S1&S2	JC	

NOTES
1. KEEP SIGHT GAUGES IN VERTICAL ALIGNMENT.
2. ALL VALVES AND GAUGES TO BE BOXED AND LABELED, THEN STRAPPED TO SHIPPING BRACE.
3. AIR TEST ALL LINES INTO VAPOR SPACE BEFORE HEAD-UP, AFTER ALL WELDING ON INSIDE OF TANK IS COMPLETED.
4. BEFORE SHIPPING :
A) INSTALL A85179 SHIPPNG COVER ON JR SG ADAPTER W/ A85181 BOLTS.

SPECIFICATIONS

O.D. 48	LGTH. 170	SH. .356	MAT'L SA-516-70
MAWP 250	PSI @ 400 °F	HD. .301	MAT'L SA-516-70
RT-4	MDMT -20°F@ 250 PSI	GAL 1250	SA 187
EXMT UG20(f)	TEST 325 PSI	WT. 3200#	CU.FT. 167.1
XRAY SPOT	W	CORR. ALW —— SH —— HD	
CRN N/A		CODE: ASME SEC. VIII DIV. 1, LATEST EDITION & ADDENDA	

WELD DETAILS: M-1932
STD. TOLERANCES (UNLESS OTHERWISE NOTED): M-2461

MANCHESTER TANK
BED1\DWG\2000\

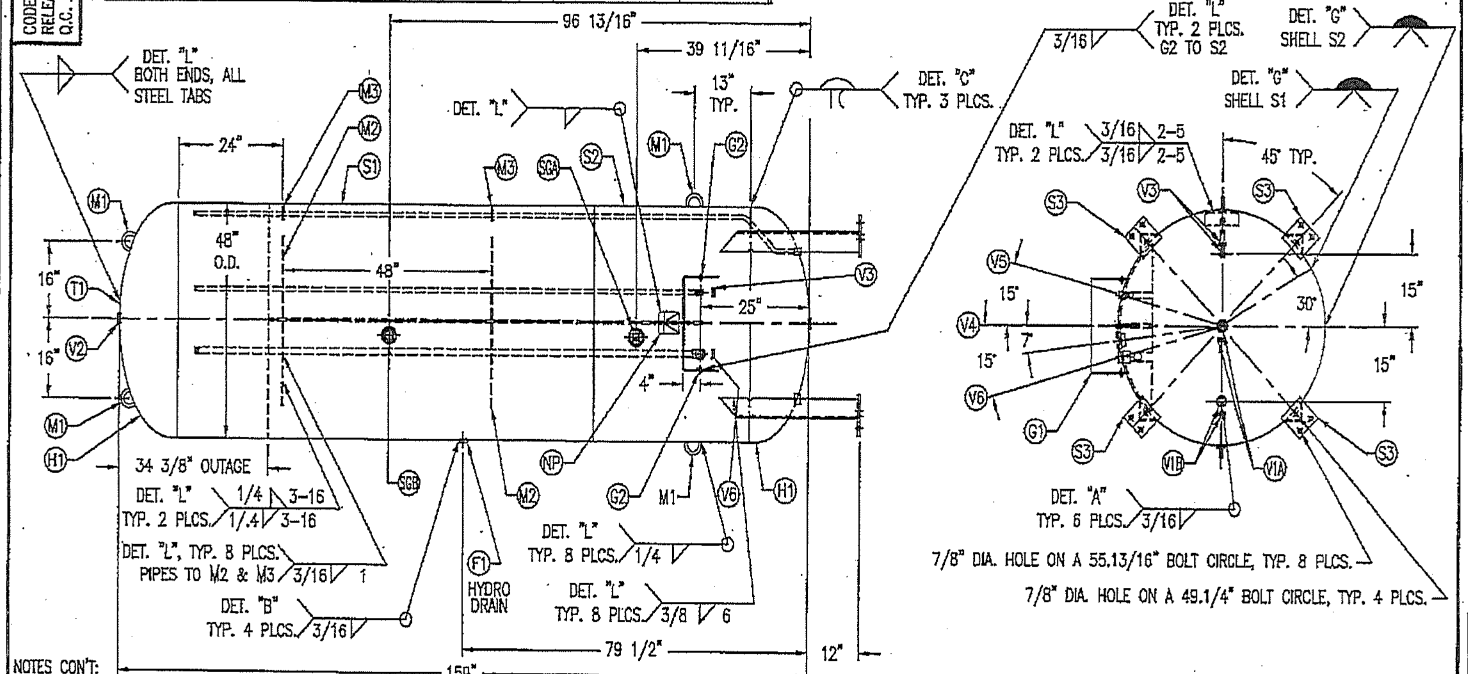
VERTICAL LP DISPENSER
1250 GAL W.C.

DRAWN BY	DATE	SCALE:
SE	02-28-96	NONE
APP. BY	DATE	DRAWING NO.
JD	06-10-96	29011

CODE/ADDENDA APPROVED
RELEASED FOR PRODUCTION
Q.C. DATE

NO.	QTY.	DESCRIPTION	SPEC	SUB-DWG.
S1	1	.356 MIN. X 96" X 150" SHELL	SA-516-70	
S2	1	.356 MIN. X 37 1/4" X 150" SHELL	SA-516-70	
H1	2	.301 MIN. X 48" O.D. 2:1 ELLIP. HEAD	SA-516-70	
F1	1	1" NPT 1500# FLAT FLANGE	SA-181-70	
V1A	1	1 1/4" NPT 1500# FLAT FLANGE	SA-181-70	
V1B	1	1 1/4" NPT 3000# HALF COUPLING	SA-105	
V2	1	1 1/4" NPT 1500# FLAT FLANGE	SA-181-70	
V3	1	3/4" NPT PIPE ASY.		A72905
V4	1	1/4" NPT PIPE ASY.		A72903
V5	1	3/4" NPT PIPE ASY.		A72904
V6	1	1 1/4" NPT PIPE ASY.		A72902

NO.	QTY.	DESCRIPTION	SPEC	SUB-DWG.
SGA	1	ADAPTOR: S.G. REC. JR.	SA-181-70	
SGB	1	ADAPTOR: S.G. NON-REC. SENIOR	SA-181-70	
M1	4	5/8" O.D. LIFT LUG		A57563
M2	2	PIPE BRACKET: 1/4" X 7 1/2" X 34"		A77662
M3	2	PIPE BRACKET: 1/4" X 2 3/4" X 8"		A91875
G1	1	GUARD: 3/16" X 8" X 8" X 18 3/4"		A53791
G2	2	GUARD CLIP		A54793
S3	4	ANGLE LEG ASY: 3/8" X 4" X 4" X 34 1/2"		A77993
T1	1	TOP TAB		V12510
NP	1	ASME DATA PLATE		A77447



NOTES CON'T:
4. BEFORE SHIPPING :
B) INSTALL A85180 SHIPPNG COVER ON SR SG ADAPTER W/ A85182 BOLTS.
C) INSTALL STEEL PLUGS IN ALL OPENINGS.
D) ATTACH SHIPPING BRACE A55742.

SYM	DATE	BY	REVISION	APP	XREF REV.
F	01-05	EGB	REDRAWN W/ BEDFORD FORMAT, SEE OBSO, OUTAGE WAS FROM ROUND SEAM, WT WAS 2878#	EGB	
G	02-05	EGB	RMV'D PIPE CLIPS, ADDED M2 & M3 BRACES, REV'D PIPES, WT WAS 2975#	EGB	
H	08-06	AW	SHELL MATERIAL WAS .387 SA-455, TEMP. WAS 650F	AW	
I	11/27/13	RB	CHANGED ANGLE LEG BRACKET MATERIAL THICKNESS	JC	

NOTES
1. KEEP SIGHT GAUGES IN VERTICAL ALIGNMENT.
2. ALL VALVES AND GAUGES TO BE BOXED AND LABELED, THEN STRAPPED TO SHIPPING BRACE.
3. AIR TEST ALL LINES INTO VAPOR SPACE BEFORE HEAD-UP, AFTER ALL WELDING ON INSIDE OF TANK IS COMPLETED.
4. BEFORE SHIPPING :
A) INSTALL A85179 SHIPPNG COVER ON JR SG ADAPTER W/ A85181 BOLTS.

SPECIFICATIONS

O.D. 48	LGTH. 159	SH. .356 MAT'L SA-516-70
MAWP 250	PSI @ 400 °F	HD. .301 MAT'L SA-516-70
RT-4	MDMT -20°F@ 250 PSI	GAL. 1150 SA 173.8
EXMT UG20(f)	TEST 325 PSI	WT. 3000# CU.FT. 153.8
XRAY SPOT	W	CORR ALW —SH — HD
CRN M4431.5		CODE: ASME SEC. VIII DIV. 1
		LATEST EDITION & ADDENDA

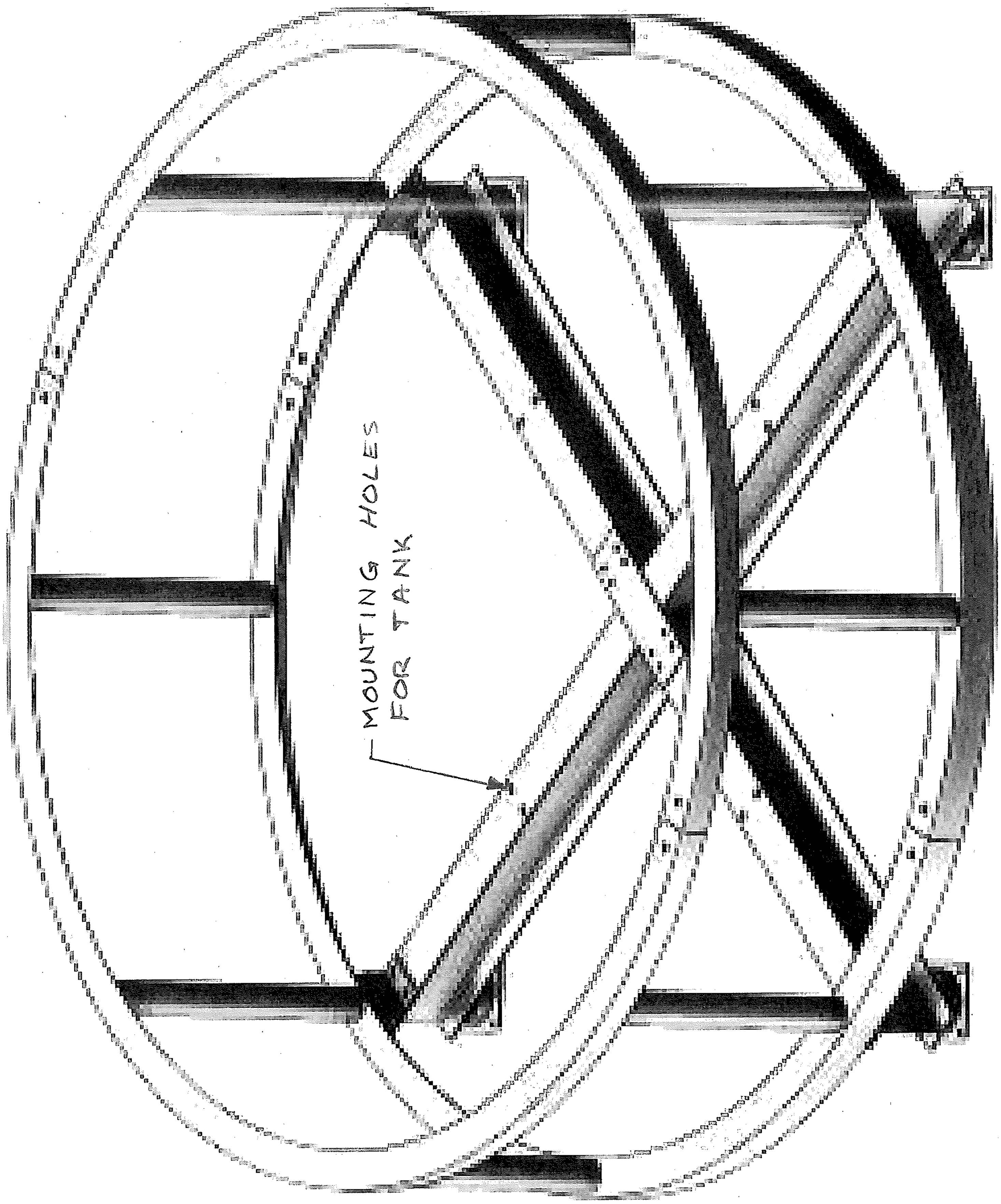
WELD DETAILS: M-1932
STD. TOLERANCES (UNLESS OTHERWISE NOTED): M-2451

MANCHESTER TANK
BED1\DWG\2000\

VERTICAL LP DISPENSER
1150 GAL W.C.

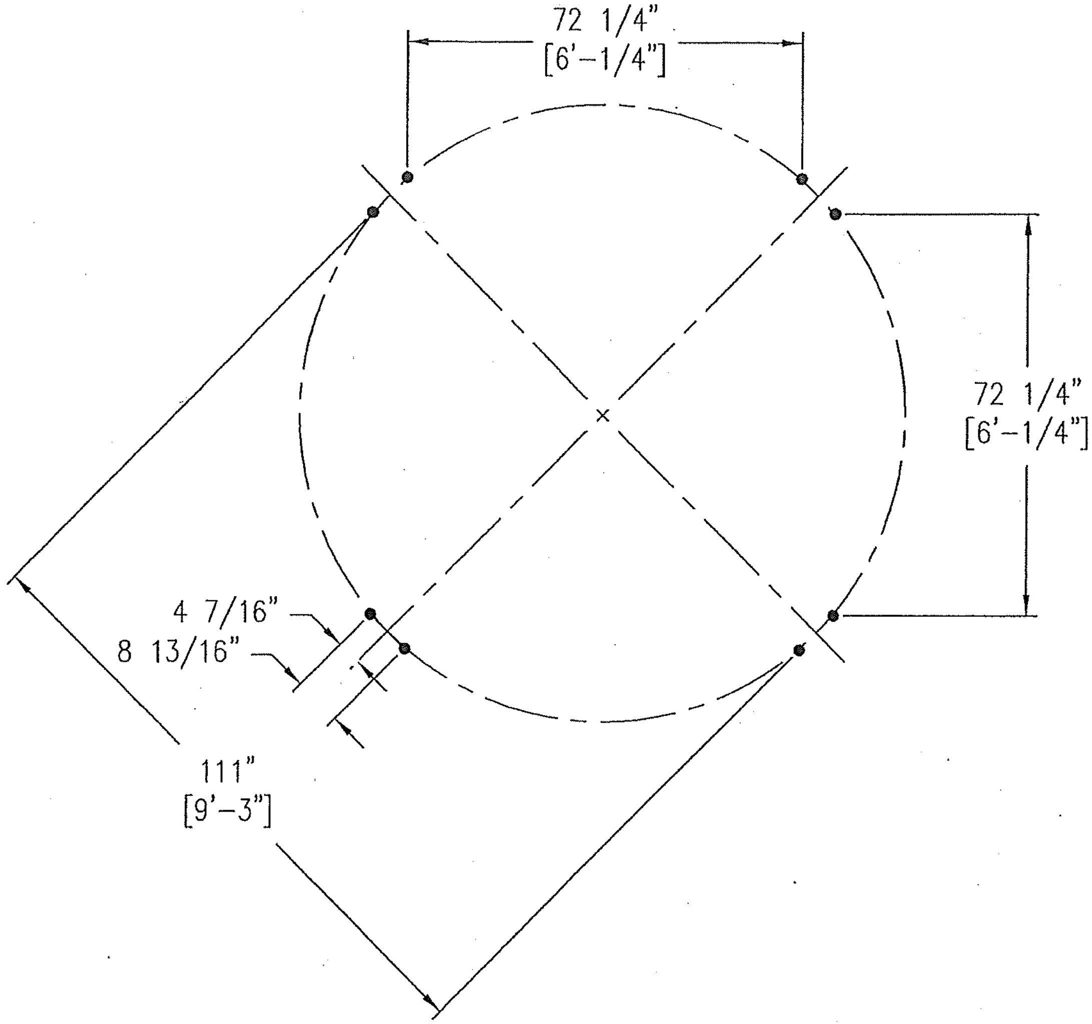
DRAWN BY	DATE	SCALE:
DN	06-03-92	NONE
APP. BY	DATE	DRAWING NO.
JS	06-15-92	22014

CRASH POST ASSEMBLY SHEET: 31

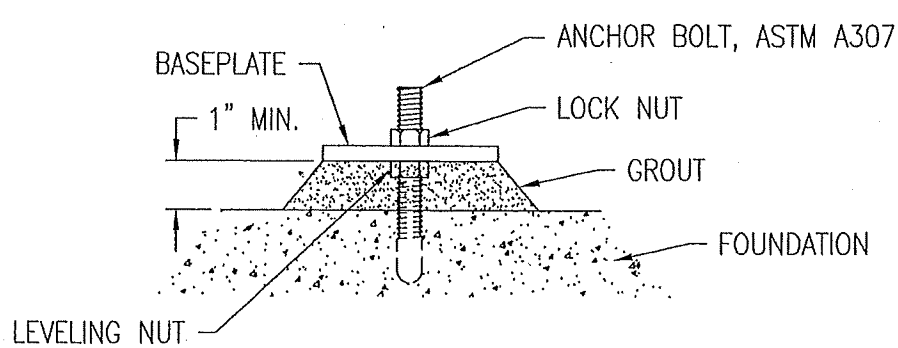


INSTALLATION DETAILS

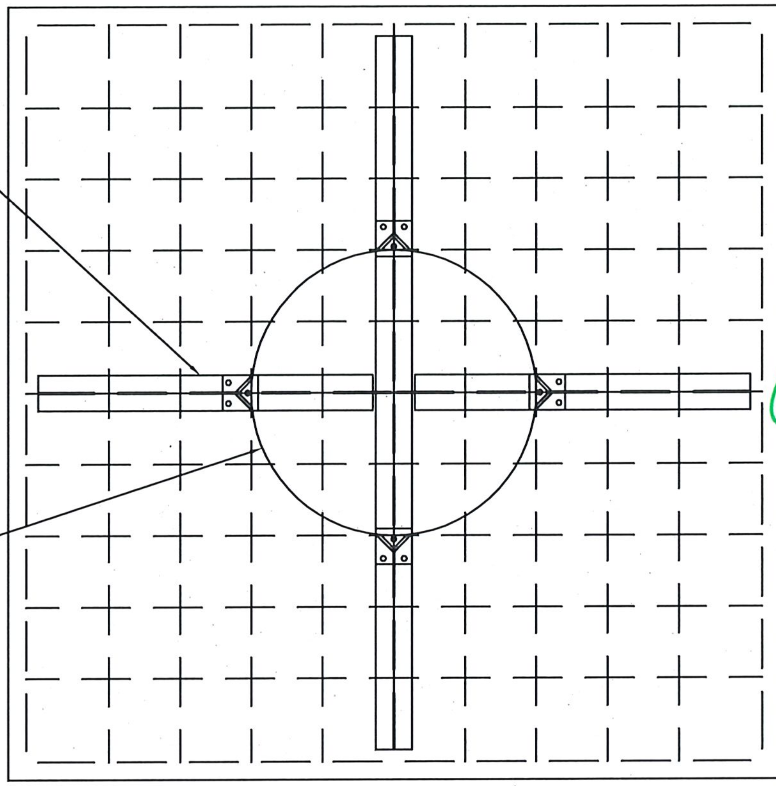
FIGURE-18A



LAYOUT BASE/BEAM ASY.



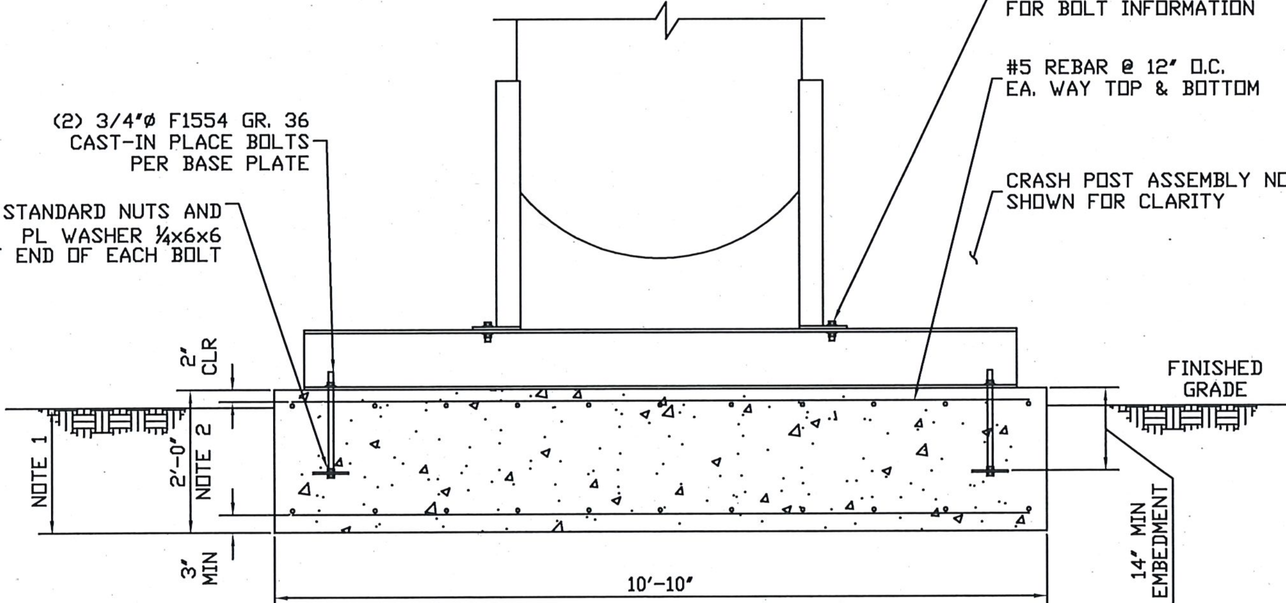
GROUTING DETAIL



WISCONSIN
CHRISTOPHER W. ANDERSON
E-45887
TIGARD
OREGON
25-OCT-17
PROFESSIONAL ENGINEER

RENEWS: 31-JUL-18

PLAN



NOTES:

1) FOR FROST DEPTH GREATER THAN THICKNESS OF SLAB, REFER TO DETAIL 2/SK2. INQUIRE TO LOCAL JURISDICTION FOR REQUIRED MIN FROST DEPTH

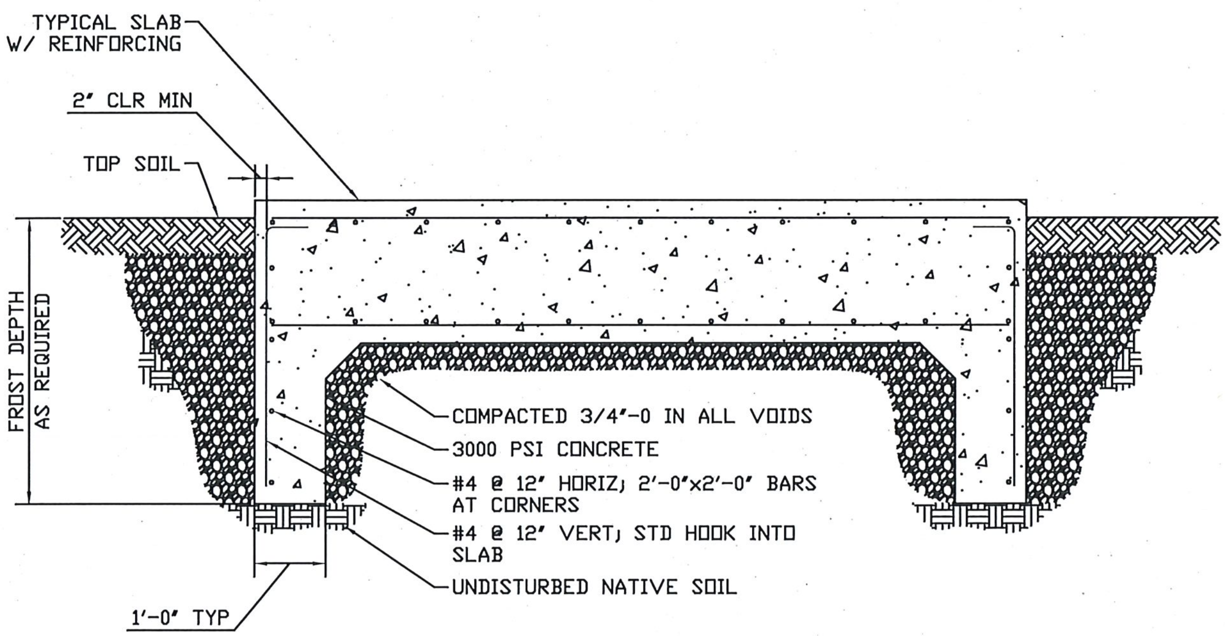
2) FOUNDATION THICKNESS MAY BE REDUCED TO 1'-6" FOR 1150 GAL AND 1250 GAL VERTICAL LP DISPENSER TANKS.

ELEVATION

1/SK1 FOUNDATION SKETCH 1

SCALE: N.T.S.

PACE An Engineering Services Company 5000 Meadows Road Suite 345 Lake Oswego, OR 97035 p. 503.597.3222 | f. 503.597.7655 Civil | Structural | Planning | Survey paceengrs.com	PROJECT: MANCHESTER TANK	DATE: 01/19/2017	PROJECT NO: 16857
	DRAWING TITLE: 1600 GAL. VERTICAL DISPENSER TANK FOUNDATION	FILE NO: -	SHEET: SK1 OF 2



NOTES:
1) FOUNDATION CAN BE MONO-POURED AS AN ALTERNATIVE.

2) f'c= 3000 PSI
Fy= 60 KSI
qu= 1500 PSF

2 / SK2 TYP SLAB W/ HIGH FROST DEPTH

SCALE: N.T.S.

PACE An Engineering Services Company	5000 Meadows Road Suite 345 Lake Oswego, OR 97035 p. 503.597.3222 | f. 503.597.7655 Civil | Structural | Planning | Survey paceengrs.com	PROJECT: MANCHESTER TANK	DATE: 01/18/2017	PROJECT NO: 16857
		DRAWING TITLE: TYPICAL SLAB W/ HIGH FROST DEPTH	FILE NO: -	SHEET: 2 OF 2