# 5'-0" SCALE PIT CALCULATIONS
# FAIRBANKS

Project Information:
Scale and Sign Owner: CAT Scale Company
Classification:V-1B (Unprotected/Unsprinkled)
Occupancy Group U - Utility - Truck Scale

Design Codes:
IBC 2015 and ASCE 7-10
IBC 2018 and ASCE 7-16
FBC 7th Edition 2020

Design Wind Speed: 115 MPH

LOCATION : Shuttle Truck Stop 75
14197 US-441
Lake City, FL 32024

DATE : 8/19/20

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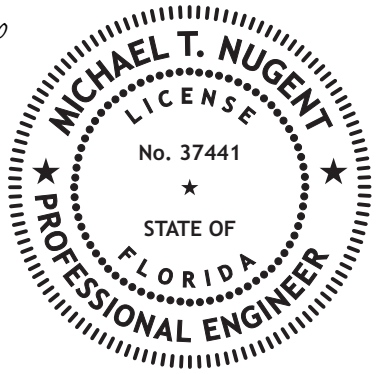
8/19/20

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LOADS
**********

| | | |
|---|---|---|
| APPROACH | $APPROACH_{TANDEM} := 32$ | kips PER AXLE ON TANDEM |
| | $APPROACH_{SINGLE} := 20$ | kips ON SINGLE |
| STEERING AXLE PLATFORM | $STEERINGAXLEPLAT := 60$ | kips |
| DRIVE AXLE PLATFORM | $DRIVEAXLEPLAT := 80$ | kips |
| TRAILER AXLE PLATFORM | $TRAILERAXLEPLAT := 120$ | kips |

APPROACH SLAB: (SECTION A-A ON DRAWINGS)
**********

LOAD ON TWO WHEELS:

$$LOAD1 := \frac{APPROACH_{TANDEM}}{4} \qquad LOAD1 = 8 \text{ kips}$$

$$LOAD2 := \frac{APPROACH_{SINGLE}}{2} \qquad LOAD2 = 10 \text{ kips}$$

USE: $LOAD := LOAD2$ $LOAD = 10$ kips

ASSUME TIRE PRESSURE = 100 psi

10 kips AT 100 PSI => Fb = 300 psi

USE 12" SLAB FOR 1000 psf

USE #4 BARS AT 8" C-C

| Soil bearing, p.s.l. | Slab thickness, in. | Maximum wheel load in 1000 lb. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flexural stress, p.s.l. | | | | | | | | | | | |
| | | 300 | | | 350 | | | 400 | | | 450 | | |
| | | Tire pressure, p.s.l. | | | | | | | | | | | |
| | | 50 | 75 | 100 | 50 | 75 | 100 | 50 | 75 | 100 | 50 | 75 | 100 |
| 10 | 5 | 11 | 8 | 7 | 14 | 10 | 9 | 18 | 13 | 11 | 21 | 16 | 13 |
| | 6 | 16 | 13 | 11 | 21 | 16 | 14 | 26 | 19 | 17 | 33 | 24 | 20 |
| | 7 | 23 | 18 | 15 | 30 | 22 | 19 | 33 | 28 | 23 | 49 | 31 | 28 |
| | 8 | 32 | 23 | 21 | 42 | 30 | 26 | * | 38 | 32 | * | 47 | 38 |
| 20 | 5 | 14 | 9 | 8 | 18 | 13 | 11 | 23 | 17 | 13 | 32 | 20 | 16 |
| | 6 | 21 | 15 | 13 | 28 | 19 | 16 | 39 | 25 | 20 | * | 32 | 24 |
| | 7 | 31 | 31 | 18 | 43 | 28 | 22 | * | 36 | 28 | * | 46 | 35 |
| 30 | 5 | 17 | 11 | 9 | 23 | 15 | 12 | 35 | 19 | 15 | * | 24 | 18 |
| | 6 | 26 | 17 | 14 | 39 | 23 | 18 | * | 30 | 22 | * | 39 | 28 |
| | 7 | 40 | 23 | 20 | * | 34 | 26 | * | 44 | 32 | * | * | 42 |
| 40 | 5 | 19 | 13 | 10 | 32 | 17 | 13 | * | 22 | 17 | * | 28 | 21 |
| | 6 | 33 | 19 | 15 | * | 27 | 20 | * | 36 | 26 | * | * | 33 |
| | 7 | * | 28 | 22 | * | 40 | 28 | * | * | 37 | * | * | 48 |
| 50 | 5 | 24 | 14 | 11 | * | 19 | 14 | * | 26 | 18 | * | 37 | 23 |
| | 6 | * | 22 | 16 | * | 31 | 22 | * | 41 | 28 | * | * | 37 |
| | 7 | * | 32 | 23 | * | 47 | 32 | * | * | 42 | * | * | * |

* Maximum wheel load exceeds 50,000 lb.

From Portland Cement Assoc. "Concrete Floors on Ground"

PIT BEARING:

**********

LOADS ARE TRANSMITTED THROUGH LOAD CELLS ON PIERS TO LONGITUDINAL WALLS. ASSUME FOOTING WIDTH OF 12" + 6" + 6" = 24"

$AREA := 2 \cdot 83 \cdot 2$ $\quad AREA = 332$ FT^2

$qs := \frac{260}{AREA} \cdot 1000$ $\quad qs = 783$ psf < 1000 psf OK

CHECK PIT SLAB FOR SHRINKAGE STEEL:

**********

$P := 0.002 \cdot 8 \cdot 12$ $\quad P = 0.192$ in^2/ft

USE: #4 BARS AT 12" C-C E.W. => A.prov = 0.20 in^2/ft OK

SECTION A-A ON DRAWINGS

CHECK PIERS AS PLAIN CONCRETE:

**********

$HT_{MAX} := 3 \cdot 24$ $\quad HT_{MAX} = 72$ in > 24 in OK

$P_{MAX1} := \frac{60 \cdot 36 \cdot 4000 \cdot 0.85 \cdot 0.9}{1.7 \cdot 1000}$ $\quad P_{MAX1} = 3888$ kips >> 35 kips OK

FOR 60" X 36" PIERS

$P_{MAX2} := \frac{30 \cdot 36 \cdot 4000 \cdot 0.85 \cdot 0.9}{1.7 \cdot 1000}$ $\quad P_{MAX2} = 1944$ kips >> 12 kips OK

FOR 30" X 36" PIERS

$P_{MAX3} := \frac{24 \cdot 36 \cdot 4000 \cdot 0.85 \cdot 0.9}{1.7 \cdot 1000}$ $\quad P_{MAX3} = 1555$ kips >> 12 kips OK

FOR 24" X 36" PIERS

USE:
(2) #5 TIES HORIZONTAL
(7) #6 VERTICALS FOR 60" X 36" PIERS
(4) #6 VERTICALS FOR 30" X 36" AND 24" X 36" PIERS

SECTION B-B ON DRAWINGS

CHECK PIT WALLS: (SECTION B-B ON DRAWINGS)

**********

USE IMPACT FACTOR OF 2.0

$W := qs \cdot 2 \cdot 2 \cdot 1.7$ $\quad W = 5325$ kips/ft

BOTTOM STEEL:

$M := 0.08 \cdot W \cdot 18^2 \cdot 12 \cdot \frac{4}{3} \cdot \frac{1}{1000}$ $\quad M = 2209$ in-kips

$As := \frac{M}{60 \cdot 0.9 \cdot 0.9 \cdot 52.5}$ $\quad As = 0.866$ in^2

$Aprov := 4 \cdot 0.31$ $\quad Aprov = 1.24$ in^2 > As OK

TOP STEEL:

$M := 0.10 \cdot W \cdot 18^2 \cdot 12 \cdot \frac{4}{3} \cdot \frac{1}{1000}$ $\quad M = 2761$ in-kips

$As := \frac{M}{60 \cdot 0.9 \cdot 0.9 \cdot 52.5}$ $\quad As = 1.082$ in^2

$Aprov := 4 \cdot 0.31$ $\quad Aprov = 1.24$ in^2 > As OK

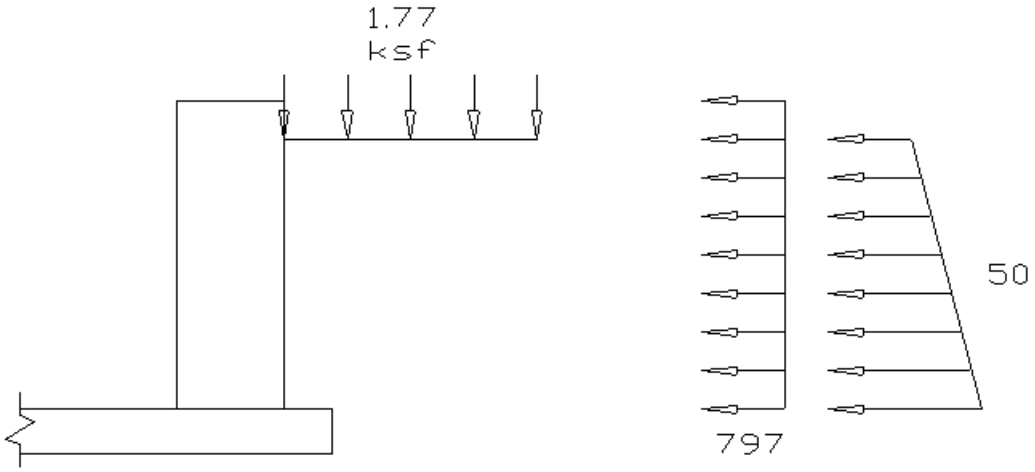
SHEAR OK BY INSPECTION

CONSIDER SURCHARGE:
**********

ASSUME A RESTRAINED WALL CONDITION WITH A 16 kip LOAD
PROVIDING MAXIMUM SURCHARGE. ASSUME LOAD IS DESTRIBUTED
THRU SOIL IN A 3'-0" SQUARE AREA.

$$q := \frac{16}{3^2} \qquad q = 1.778 \qquad \text{ksf}$$

$$EQUIVSOILHT := \frac{q \cdot 1000}{110} \qquad EQUIVSOILHT = 16.2 \qquad \text{ft}$$




Design wall as restrained at top and bottom.

Consider 12 long segment:

$$M := .125 \cdot \left(797 \cdot \frac{4.5^2}{2} + \frac{50}{2} \cdot \frac{4.5^2}{2}\right) \qquad M = 1040 \qquad \text{ft-\#}$$

$$As := \frac{1.7 \cdot M \cdot 12}{.9 \cdot .9 \cdot 60000 \cdot 9.5} \qquad As = 0.05 \qquad \text{in\^2/ft}$$

$$Aprov := \frac{0.20}{1.5} \qquad Aprov = 0.13 \qquad \text{in\^2/ft}$$

One #4 each 18 inches

Aprov = As OK
SECTION B-B ON DRAWINGS

SIGN CALCULATIONS
Revised July 2017

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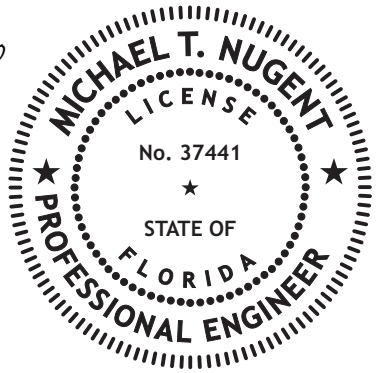


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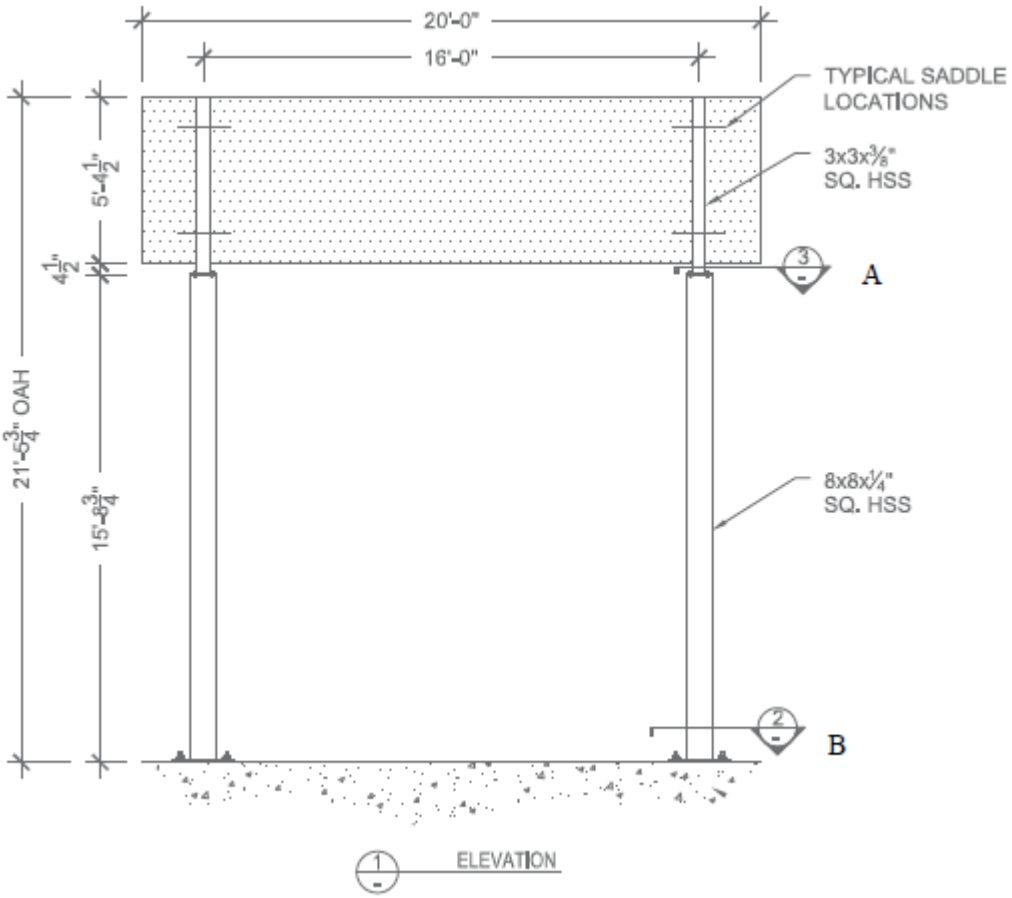
SIGN CALCULATIONS






Design Wind: 115 MPH Exposure C

$DL := 1300$ #

$Fy_{TUBE} := 46$ ksi

$Fy_{PLATE} := 36$ ksi

$fc := 4000$ psi

$fweld := 70000$ psi

BOLTS A307B

Exposure C — ASCE-7 26.7

Category II — ASCE-7 Table 1.5-1

$Kzcolumns := .85$ — ASCE-7 29.3.1, Use height of >15'

$Kzsign := .885$ — ASCE-7 29.3.1, Use height of 18.5'

$Kzt := 1.0$ — ASCE-7 Section 26.8 assumes flat terrain

$Kd := 0.85$ — ASCE-7 Table 26.6-1

$V := 115$ 3 sec gust in MPH — ASCE-7 Figure 26.5-1A

$qzcolumns := 0.00256 \cdot Kzcolumns \cdot Kzt \cdot Kd \cdot V^2$ — ASCE-7 Eq. 29.3-1

$qzsign := 0.00256 \cdot Kzsign \cdot Kzt \cdot Kd \cdot V^2$ — ASCE-7 Eq. 29.3-1

$qzcolumns = 24.46$ (lb/ft^2)

$qzsign = 25.47$ (lb/ft^2)

$G := 0.85$ — ASCE-7 29.3-1

$Cfcolumn := 2.0$ — ASCE-7 29.5-1

B/S=3.64 s/h=.26 — ASCE-7 29.4-1

$Cfsign := 1.8$

$Pcolumns := qzcolumns \cdot G \cdot Cfcolumn$

$Pcolumns = 41.584$

$Psign := qzsign \cdot G \cdot Cfsign$

$Psign = 38.966$

$Afsign := 5.333 \cdot 20$

2 pole factor = .75 Fig 29.4-1 asce 7

$Afcolumn := 0.667 \cdot 16 \cdot 2$

$Fsign := Afsign \cdot Psign \cdot .75$

$Fsign = 3117.11$

$Fcolumn := Afcolumn \cdot Pcolumns \cdot .75$

$Fcolumn = 665.671$

$Ftotal := Fsign + Fcolumn$

$Ftotal = 3782.781$

To convert to allowable stress; multiply by .6 — IBC 1605.3

$ASD := .6$

$F_B := ASD \cdot Ftotal$ $F_B = 2269.668$ ft-#

$M_A := ASD \cdot Fsign \cdot \frac{5.75}{2}$ $M_A = 5377$ ft-#

$M_B := ASD \cdot \left( M_A + (Fcolumn) \cdot \frac{16}{2} + (Fsign) \cdot 16 \right)$ $M_B = 36346$ ft-#

FOR 3"x3"x 5/16" TUBE
**********

$A_3 := 3.11$ in^2

$S_3 := 2.39$ in^3

$I_3 := 3.58$ in^4

$r_3 := 1.07$ in

FOR 8"x8"x1/4" TUBE
**********

$A_8 := 7.59$ in^2

$S_8 := 18.8$ in^3

$I_8 := 75.1$ in^4

$r_8 := 3.15$ in

CHECK 3x3 TUBE
**********

$fb := \frac{M_A \cdot 12}{S_3}$ $fb = 26998$ psi

$fa := \frac{\frac{DL}{2}}{A_3}$ $fa = 209$ psi

$\frac{fb}{0.6 \cdot 46000} + \frac{fa}{0.6 \cdot 46000} = 0.986$ < 1.33 OK

CHECK 8x8 TUBE
**********

$fb := \frac{M_B \cdot 12}{S_8}$ $fb = 23199$ psi

$fa := \frac{\frac{DL}{2} + 16 \cdot 26}{A_8}$ $fa = 140$ psi

$\frac{fb}{0.6 \cdot 46000} + \frac{fa}{0.6 \cdot 46000} = 0.846$ < 1.33 OK

CHECK COLUMN BASEPLATE
**********

$P := \frac{DL}{2} + 16 \cdot 26$ $\quad P = 1066$ #

$M_B = 36346$ ft-#

TRY: (8) 1 1/8" DIA. BOLTS

$P_{BOLT} := \frac{M_B \cdot 12}{18 \cdot 3} - \frac{DL}{8}$ $\quad P_{BOLT} = 7914$ #

$P_{ALLOW} := 1.33 \cdot 0.6 \cdot 36000 \cdot .994$ $\quad P_{ALLOW} = 28556$ #

P.ALLOW > P.BOLT OK

$fb := \frac{3 \cdot P_{BOLT} \cdot (9-4) \cdot 6}{1.25^2 \cdot 18}$ $\quad fb = 25326$ psi

$Fb := 1.3 \cdot .66 \cdot 36000$ $\quad Fb = 30888$ psi

Fb > fb OK

3" TUBE WELD (CHECK 1/4" FILLET WELD ALL AROUND)
**********

$S := 3.3125^2 + \frac{3.3125^2}{3}$ $\quad S = 14.63$

$Wb := \frac{M_A \cdot 12}{S}$ $\quad Wb = 4410$ #/in

$fv := \frac{Wb}{.25 \cdot .707}$ $\quad fv = 24952$ psi

$Fv := 0.3 \cdot 1.33 \cdot 60000$ $\quad Fv = 23940$ psi

Fv > fv OK FOR E7018

8" TUBE WELD (CHECK 1/4" FILLET WELD ALL AROUND)
**********

$S := 8^2 + \frac{8^2}{3}$ $\quad S = 85.333$

$Wb := \frac{M_B \cdot 12}{S}$ $Wb = 5111$ #/in

$fv := \frac{Wb}{.25 \cdot .707}$ $fv = 28917$ psi

$Fv := 0.3 \cdot 1.33 \cdot 60000$ $Fv = 23940$ psi

Fv > fv OK FOR E7018

CHECK 3/4" BOLTS AT A

**********

$P_{BOLT} := \frac{M_A \cdot 12}{4 \cdot 2.75}$ $P_{BOLT} = 5866$ #

$P_{ALLOW} := 1.33 \cdot .6 \cdot .4412 \cdot 36000$ $P_{ALLOW} = 12675$ #

P.ALLOW > P.BOLT OK

SIGN FOUNDATION

**********

THE FOUNDATION FOR THE SIGN IS THE SCALE PIT. THE PIER TO WHICH THE SIGN COLUMN BASE PLATE IS ATTACHED IS POURED MONOLITHICALLY ON THE EXTERIOR OF THE LONGITUDINAL PIT WALL AT THE EXIT END OF THE SCALES. THE BEARING AREA AND SECTION MODULUS OF THE WALL FOOTING IS 332 SQUARE FEET AND 4704 CUBIC FEET RESPECTIVELY. THE LOADS IMPOSED BY THE SIGN ARE VERY SMALL COMPARED TO THE SCALE LOADING.

SIGN FOUNDATION OK BY INSPECTION AND COMPARISON WITH THE SCALE FOUNDATION.