FLSmidth

PLANT SYSTEMS GROUP - SALT LAKE CITY, UTAH

CALCULATION COVER SHEET

JOB NUMBER	CLIENT	PROJECT	CALC. NUMBER
11021	CC&V	High Grade Ore	C-001

TITLE/SUBJECT:

Grassy Valley Pipeline
Mill Water Tank Ring Wall Foudnation

STATEMENT OF PROBLEM:

Design the foundation for a 45'-0 diameter soil supported water tank. Design the pump foundations for the new pumps in Grassy Valley.

P.E. SEAL

COLORADO LICENSED
EDWARD CARTER SUMMERS
45828
7-23-12
PROFESSIONAL ENGINEER

SOURCES OF DATA, FORMULA & REFERENCES:

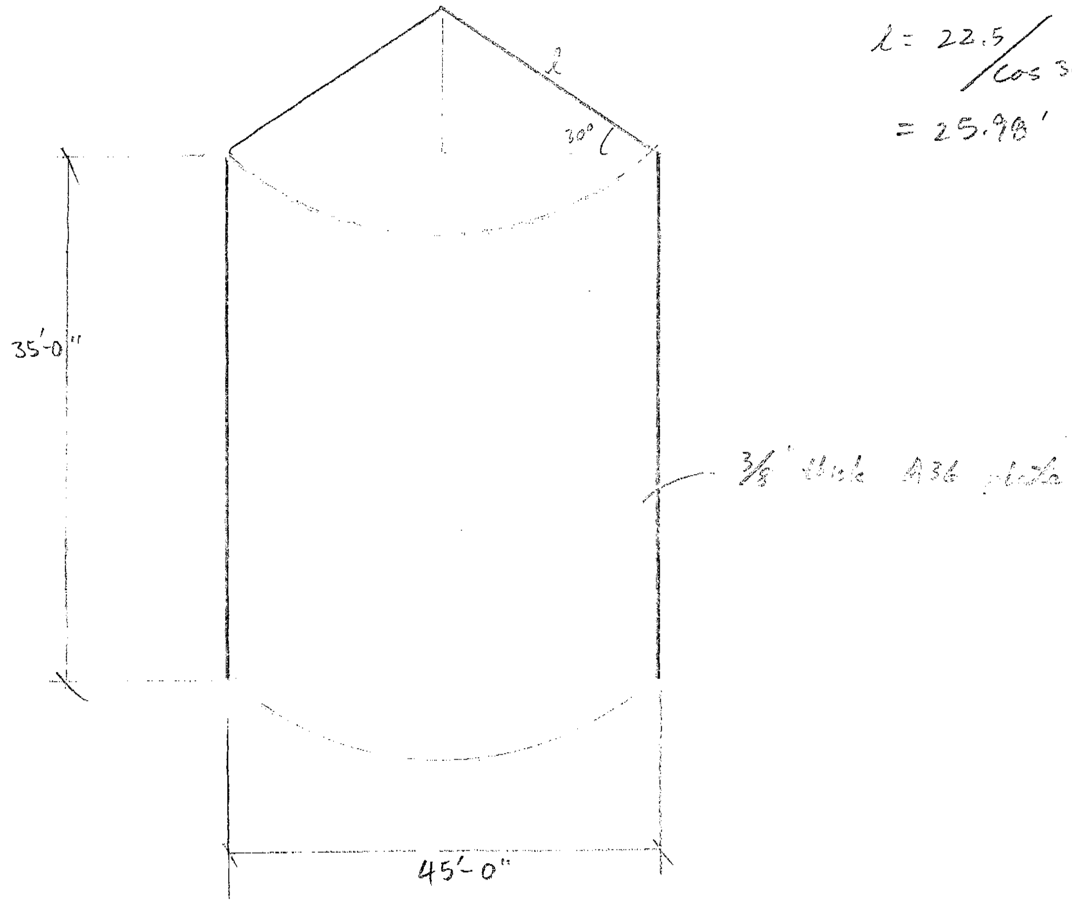
AutoDesk Robot Structural Analysis Professional 2012
Mechanical Drawing on proposed water tank
ASCE /SEI 7-10 for Wind Load and Seismic Load
ACI 350.3 Appendix B (Sloshing)
AMEC Soils Report

CONCLUSIONS & RECOMMENDATIONS:

See details in report

REV	DATE	DESCRIPTION/STATUS	CALC BY	CHKD BY	DWG./SPECS REVISED	QA REVIEW
A	Oct-11	Ready for Check	Wchan	ES		
0	Jul-12	Issued for Permit	Wchan	ES		

FLSmidth	PROJECT CC4/1 Grassy Valley Pipeline	PROJ NO. 11021	
	SUBJECT Ring Wall Foundation on Mill Water Tank (Steel version)	CALC NO. C-002	
		BY W. Chen	DATE 10/14/2011
		CHK	DATE
		SHEET OF	REV



$l = 22.5 / \cos 30°$

$= 25.98'$

Load Applied:

<u>Tank DL</u> $= 3/8" \times (2\pi r h + \pi r^2 + \pi r l) \times 490$ pcf

$= (3/8)/12 \times [45 \times 35 \times \pi + \pi (45)^2/4 + \pi (22.5)(25.98)] \times 0.49$ kcf

$= 128.24$ kips

Distribute DL on top of ring wall rim $= 128.24 / 2\pi r = 128.24 / 45\pi$

$= 0.907$ kip/ft.

<u>Material LL</u> $= 62.4$ pcf $\times \pi r^2 \times h = 0.0624 \times \pi (45)^2/4 \times 35 = 3473.5$ kips

Distribute LL on bottom of tank $= 3473.5 / \pi r^2 = 3473.5 / (\pi (45)^2/4) = 2.184$ ksf

<u>Snow L</u> $= 40$ psf

Distribute over the rim $= 40$ psf $\times \pi r l / 2\pi r = 40 \times \pi (45/2)(25.98) / 45\pi = 0.5196$ k/ft

FLSMIDTH	PROJECT	PROJ NO. 11021
		CALC. NO. C-001
	SUBJECT	BY wchen DATE 10/14/2011
		CHK DATE
		SHEET OF REV

Wind Load =

$V = 90$ mph

Exp = C

$K_{zt} = 1.0$

$G = 0.85$

$K_z = 1.04$

$K_d = 0.95$

$q_z = 0.00256 (K_z)(K_{zt})(K_d) V^2$
$= 0.00256 (1.04)(1.0)(0.95)\, 90^2$
$= 20.487$

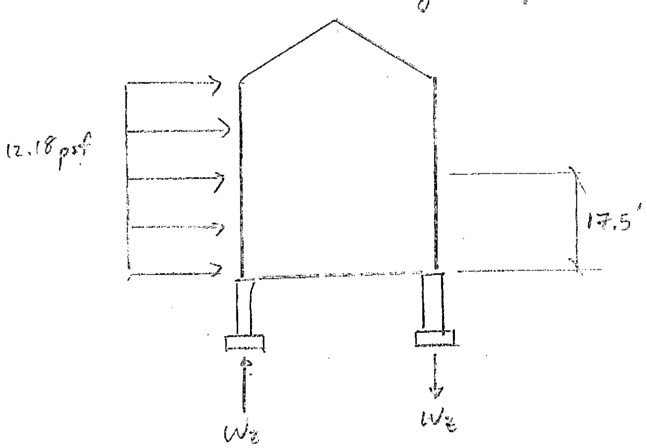
$F = q_z G C_f A_f$

$D\sqrt{q_z} = 45\sqrt{20.480}$
$= 203.6572.5$

$\therefore C_f = 0.7.$

$F/A_f = 20.487 (0.85)(0.7)$
$= 12.18$ psf

Distribute along top rim of ring wall as coupling load:



$12.18\text{psf} \times 35' \times 45' / 1000 \times 17.5' = W_z\ 45'$
$W_z = 7.46$ kips

Distribute along the rim (half)
$= W_z / \frac{1}{2}(2\pi r)$
$= \frac{7.46}{\pi(\frac{45}{2})} = 0.1055$ kip/ft.

Seis Load =

For rigid non-building structure, $C_s = 0.064$.

$V = C_s W$
$V = 0.064 (128.24)$
$= 8.207$ kips

Distribute along top rim of ring wall as coupling load:

FLSMIDTH	PROJECT	PROJ NO.
		CALC NO.
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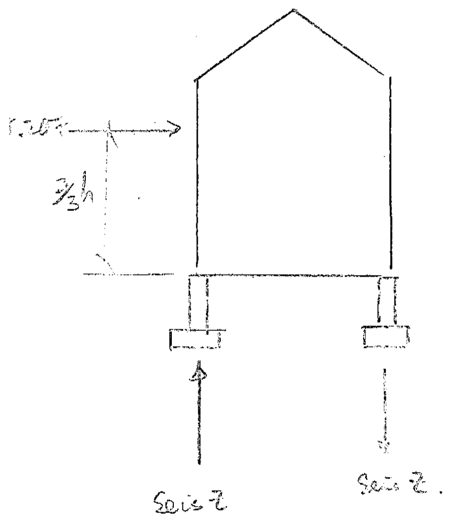


$8.297\left(\frac{2}{3}\right)35' = \text{Seis } Z \; (45')$

$\text{Seis } Z = 4.255 \text{ kips}$

Distribute along perimeter (half)

$= \text{Seis } Z / \frac{1}{2}(2\pi r)$

$= 4.255 / \pi\left(\frac{45}{2}\right) = 0.06 \text{ kip/ft.}$

Base Shear from sloshing $= 199.29$ kip / 45 ft
(by MathCAD worksheet) $= 1.4097$ k/ft

Allowable Soils bearing (by AMEC soil report) = 3500 psf.

Seismic Design of Steel Circular Tanks

per ACI 350.3, ASCE 7-05

Tank Properties:

$D := 45ft$ Tank Diameter

$H := 35ft$ Height of Tank

Seismic Properties:

$S_a := .213$ Spectral Acceleration (% of g)

$I := 1.0$ Importance Factor

$R := 3$ Response Factor

$u_v := 0.043$ Vertical Acceleration (% of g)

Material Properties:

$W_L := 3473500lbf$ Weight of Material

$W_w := 100120lbf$ Weight of Tank

$W_r := 28120lbf$ Weight of Roof

$$W_i := \frac{\tanh\left(0.866\cdot\frac{D}{H}\right)\cdot W_L}{0.866\cdot\left(\frac{D}{H}\right)} = 2.512\times 10^3\cdot kip$$ Weight of Impulsive Material

$$W_c := 0.230\cdot\left(\frac{D}{H}\right)\cdot\tanh\left(3.68\cdot\frac{H}{D}\right)\cdot W_L = 1.02\times 10^3\cdot kip$$ Weight of Convective Material

Force Center of Gravity:

$$h_w := \frac{H}{2} = 17.5\cdot ft$$ Wall Center of Gravity

$$h_r := H = 35\cdot ft$$ Roof Center of Gravity

$$h_i := 0.375\cdot H = 13.125\cdot ft$$ Impulsive Center of Gravity

$$h_c := \left[1 - \frac{\cosh\left(3.68\cdot\frac{H}{D}\right) - 1}{3.68\cdot\left(\frac{H}{D}\right)\cdot\sinh\left(3.68\cdot\frac{H}{D}\right)}\right]\cdot H = 24.094\cdot ft$$ Convective Center of Gravity

Vertical Forces:

$P_v := u_v \cdot W_w = 4.305 \cdot kip$ — Force due to Wall

$P_r := u_v \cdot W_r = 1.209 \cdot kip$ — Force due to Roofl

$q_h := \gamma \cdot H = 0.09 \dfrac{s^2 \cdot in^2}{lb} \cdot ksf$ — Liquid Pressure

$Q_h := q_h \cdot \left(\dfrac{D}{2}\right) = 2.034 \times 10^3 \dfrac{s^2 \cdot in^2}{lb} \cdot plf$ — Liquid Force per ft of Wall

Shear Forces:

$\varepsilon := \min\left[0.0151\left(\dfrac{D}{H}\right)^2 - 0.1908 \cdot \left(\dfrac{D}{H}\right) + 1.021, 1\right] = 0.801$ — Effective Mass Coefficient

$P_w := \dfrac{S_a \cdot I \cdot \varepsilon \cdot W_w}{R} = 5.691 \cdot kip$ — Base Shear due to Wall

$P_r := \dfrac{(S_a) \cdot I \cdot \varepsilon \cdot W_r}{R} = 1.599 \cdot kip$ — Base Shear due to Roof

$P_i := \dfrac{S_a \cdot I \cdot W_i}{R} = 178.363 \cdot kip$ — Base Shear due to Impulsive Weight

$P_c := \dfrac{S_a \cdot I \cdot W_c}{R} = 72.454 \cdot kip$ — Base Shear due to Convective Weight

$V := \sqrt{\left(P_i + P_w + P_r\right)^2 + P_c^{\,2}} = 199.29 \cdot kip$ — Total Base Shear

Overturning Forces:

$M_w := P_w \cdot h_w = 99.6 \cdot kip \cdot ft$ — Overturning Moment due to Wall

$M_r := P_r \cdot h_r = 55.948 \cdot kip \cdot ft$ — Overturning Moment due to Wall

$M_i := P_i \cdot h_i = 2.341 \times 10^3 \cdot kip \cdot ft$ — Overturning Moment due to Impulsive Force

$M_c := P_c \cdot h_c = 1.746 \times 10^3 \cdot kip \cdot ft$ — Overturning Moment due to Convective Force

$\boxed{M := \sqrt{\left(M_i + M_w + M_r\right)^2 + M_c^{\,2}} = 3.046 \times 10^3 \cdot kip \cdot ft}$ — Total Overturning Moment

Unanchored Tank Requirements:

Per AWWA D100 Section 13.3

$t_b := 0.1875\text{in}$ Tank Bottom Thickness

$\sigma_y := 36\text{ksi}$ TankYield Stress

$\gamma := 62.4\text{pcf}$ Unit weight of tank material

Overturning Check:

$w_L := \min\left(t_b \cdot \sqrt{\sigma_y \cdot H \cdot \gamma}, 0.02 \cdot H \cdot D \cdot \gamma\right) = 1.663 \times 10^3 \cdot \frac{\text{lbf}}{\text{ft}}$ Maximum weight of tank contents per length of shell

$w_t := \frac{\left(W_w + W_r\right)}{\pi \cdot D} = 0.907 \cdot \frac{\text{kip}}{\text{ft}}$ Weight of Tank Shell and Roof per length of Shell

$M_{r.} := \left(w_L + w_t\right) \cdot (\pi \cdot D) \cdot \frac{D}{2} = 8.174 \times 10^3 \cdot \text{kip} \cdot \text{ft}$ Overturning Resistance

$\boxed{\text{Overturning}_{\text{Ratio}} := \frac{M_{r.}}{M} = 2.683}$ Overturning Ratio

Sliding Check:

$\mu := 0.3$ Friction Coefficient

$V_r := \left(W_L + W_w + W_r\right) \cdot \mu = 1.081 \times 10^3 \cdot \text{kip}$ Sliding Resistance

$\boxed{\text{Sliding}_{\text{Ratio}} := \frac{V_r}{V} = 5.422}$ Sliding Ratio

Annulus Plate Design:

$t_s := 0.375\text{in}$ Tank Annulus Thickness

$E := 29000\text{ksi}$ Modulus of Elasticity

$L := 1.7 \cdot t_b \cdot \sqrt{\frac{\sigma_y}{H \cdot \gamma}} = 1.294 \cdot \text{ft}$ Annulus Required width

$L_{\text{limit}} := 0.035 \cdot D = 1.575 \cdot \text{ft}$ If L>0.035D, Then Tank must be anchored

Seismic Allowable Stress:

$P := \gamma \cdot H = 15.167\,psi$ — Hydrostatic Pressure at Base

$\frac{P}{E} \cdot \left(\frac{D}{2t_s}\right)^2 = 0.271$ — Criteria to be used with Figure 11

$\Delta C_c := 0.18$ — Pressure stabilizing buckling coefficient (From Figure 11)

$\Delta\sigma_{cr} := \frac{2(\Delta C_c \cdot E \cdot t_s)}{D} = 7.25 \cdot ksi$ — Critical Buckling Stress

$\frac{2 \cdot t_s}{D} = 1.389 \times 10^{-3}$ — Criteria to be used with Table 10

$\sigma_a := 2467psi$ — Allowable Compression Stress (from Table 10)

$\boxed{\sigma_e := 1.33 \cdot \left(\sigma_a + \frac{\Delta\sigma_{cr}}{2}\right) = 8.102 \cdot ksi}$ — Seismic Allowable Stress

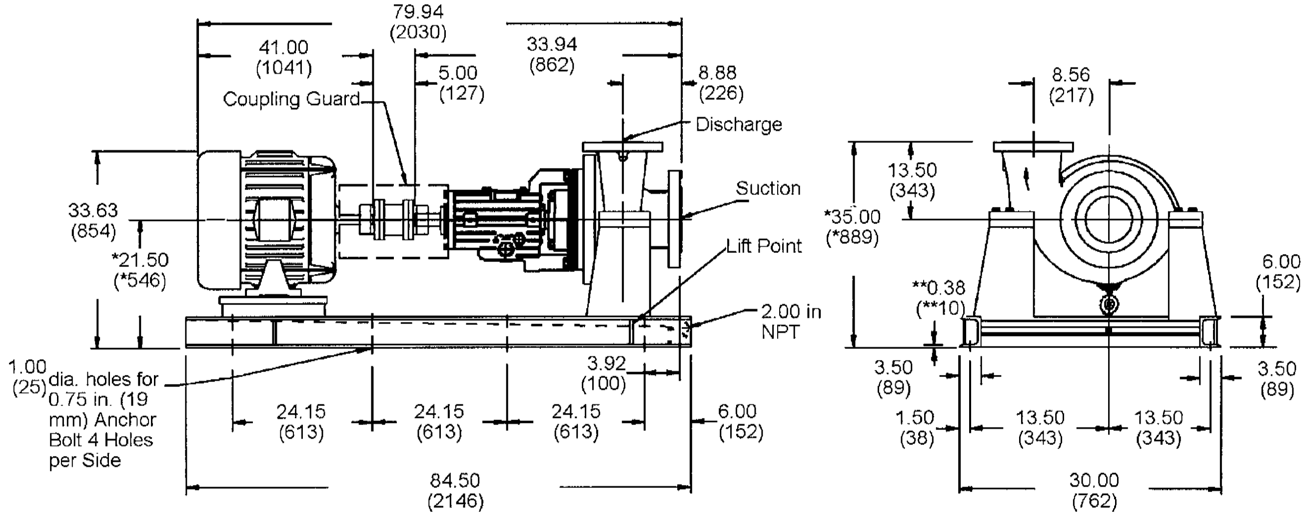
Shell Longitudinal Stress:

$uplift := \frac{M}{D^2 \cdot (w_t + w_L)} = 0.585$ — Uplift Check: uplift occurs if greater than 0.785, and less than 1.54

$\sigma_{c1} := \left(w_t + \frac{1.273 \cdot M}{D^2}\right) \cdot \frac{1}{t_s} = 0.627 \cdot ksi$ — Shell Compression Force (no uplift)

$\boxed{\sigma_{c2} := \left(\frac{w_t + w_L}{0.607 - 0.187 \cdot uplift^{0.67}} - w_L\right) \cdot \frac{1}{t_s} = 0.829 \cdot ksi}$ — Shell Compression Force (uplift)

REQ'D TANK BOTTOM = PL 3/16"
REQ'D ANNULUS PLATE = PL 3/8"
REQ'D ANNULUS WIDTH = 1'-4"



Pump Specification

SUCT.FLANGE SIZE *6"*	DRILLING *ANSI 300#*	FACING *RF*	FINISH *SERRATED*
DISCH.FLANGE SIZE *3"*	DRILLING *ANSI 300#*	FACING *RF*	FINISH *SERRATED*
PUMP ROTATION (LOOKING AT PUMP FROM MOTOR) *CCW*			
TYPE OF LUBRICATION *RING OIL*		COOLED *NO*	
TYPE OF STUFFING BOX *STANDARD NON COOLED*		COOLED *NO*	
TYPE OF SEALING *MECHANICAL SEAL*			

Weights and Measurements

PUMP	738.0 lb
MOTOR/CPLG	1,615.0/11.0 lb
BASEPLATE	846.0 lb
TOTAL	3,210.0 lb
GR.VOLUME w/BOX	180.5 ft³
GR.WEIGHT w/BOX	4,113.0 lb

Motor Specification

MOTOR BY *PUMP MFG*	MOUNT BY *PUMP MFG*	MFG. *PUMP MFG'S CHOICE*
FRAME *445TS*	POWER *150.0 hp*	RPM *3600*
PHASE *3*	FREQUENCY *60 HZ*	VOLTS *460*
INSULATION *F*	S.F. *1.15*	
ENCLOSURE *SEVERE DUTY/MILL AND CHEMICAL PREMIUM EFFICIENCY*		

Notes and References

- MTR DIMENSIONS ARE APPROXIMATE
- ALLOW FROM 1.00 to 2.00in.(25 to 51mm) FOR GROUTING. SEE INSTRUCTION BOOK FOR DETAILS.
- ANCHOR BOLTS SUPPLIED BY OTHERS

* Tolerance is +0.12 -0.25 (+3 -6)

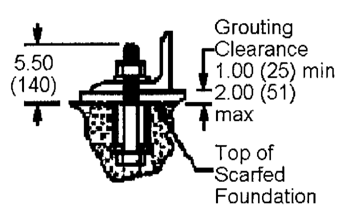
** Foundation bolt grip thickness

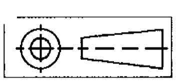
FOR PUMP TAPPED OPENINGS REFER TO DWG.: T090111-LD1 / ITEM 001

Auxiliary Specification

COUPLING BY *PUMP MFG*	CPLG TYPE *METASTREAM TSCS 0033*
CPL GUARD BY *PUMP MFG*	CPLG GUARD MATL *STEEL*
BASEPLATE *FABRICATED CHANNEL STEEL – MOTOR J/BOX MAY OVERHANG THE BASE PLATE API No 02*	
MECH.SEAL *JOHN CRANE 5610Q XF(55)1O(58)H*	

Typical Anchor Bolt Installation





DRAWING IS FOR REFERENCE ONLY.
NOT CERTIFIED FOR CONSTRUCTION UNLESS SIGNED.

Customer: QUADNA
Serial No:
Customer P.O. No:
Item No: ITEM 001
End User: RMS
Service:

All dimensions are in : in.(mm).
Drawing is not to scale
Weights lbs (kg) are approximate

DRAWING NO 090111-LD1/ITEM 001

FLSmidth	PROJECT LC&V HIGH GRADE ORE	PROJ NO. 11021	
		CALC NO. C-001	
	SUBJECT GRASSY VALLEY PUMP HOUSE	BY ECS	DATE 7-19-12
		CHK	DATE
		SHEET OF	REV

PUMP FOUNDATION

DEAD LOAD = PUMP = 738 #
MOTOR = 1,615 #
BASEPLATE = 846 #

TOTAL = 3,210 #

MAKE FOUNDATION 3-4 TIMES PUMP MASS

(3'-6" x 4'-0" x 7'-3")(150 PCF) = 15,225#

RATIO = 15,225# / 3,210# = 4.7 OK

BEARING PRESSURE (INCLUDING CONCRETE WEIGHT)

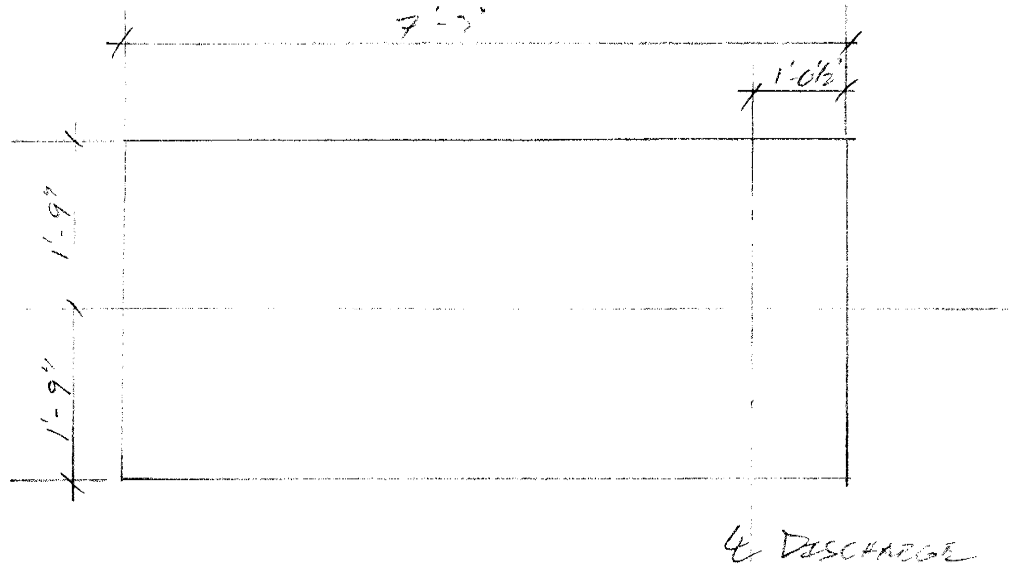
P = (15,225# + 3,210#) / (3'-6" x 7'-3")

= 726 PSF OK

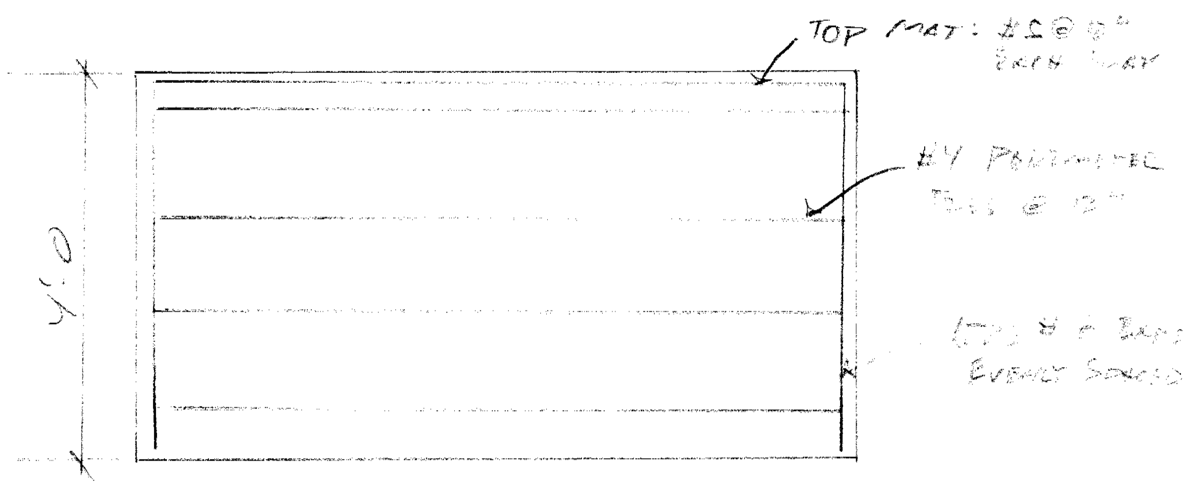
BY INSPECTION SEISMIC & VIBRATION
ANALYSIS ARE NOT NEEDED DUE
TO MASS OF CONCRETE & LOW STATIC
BEARING PRESSURE

FLSMIDTH	PROJECT CC&V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-001
	SUBJECT GREASY VALLEY PUMP HOUSE	BY ECS DATE 7-19-12
		CHK DATE
		SHEET OF REV

PUMP FOUNDATION



PLAN



ELEVATION