Engineers
Planners
Economists
Scientists

MACS ID# 39859
Permit # SC09-272928

November 6, 1995

130308.AO.80

Kim B. Ford, P.E.
Solid Waste Section
Florida Department of Environmental Protection
3804 Coconut Palm Drive
Tampa, FL 33619

Dear Mr. Ford:

Subject: Citrus County Central Landfill
Leachate Storage Tank
Permit No.: SC09-272928

The purpose of this correspondence is to provide additional information to your office regarding Citrus County's request for a leachate storage tank construction permit. This additional information is intended to supplement the correspondence from Ms. Susan Metcalfe to your office dated October 23, 1995. The information follows in the order in which it was discussed during our telephone conversation on November 3, 1995.

1. CH2M HILL has reviewed and assisted in the preparation of the correspondence from Ms. Susan Metcalfe to your office dated October 23, 1995; and concurs with the engineering conclusions included therein.

2. A revised Paragraph 3.04 SITE PREPARATION/EARTHWORK of Section 02200 EARTHWORK of the Project Manual is attached. The paragraph has been revised to replace the words "should" with "shall" and will be included in a change order to the existing construction contract with the leachate storage tank contractor.

3. The geotechnical exploration report prepared by PSI included a recommendation for a minimum depth of 2 feet between the bottom of the tank foundation and the lowest exterior final grade. This recommendation is consistent with typical design requirements for foundations in vegetated areas. However, the tank foundation will be surrounded concrete surfacing from the secondary containment surrounding the tank. During design of the tank, PSI was contacted to reevaluate

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their recommendation with this in consideration. In a February 24, 1995 letter, a copy of which is attached, they stated that the tank floor slab could be placed at ground surface. Therefore, the depth of the leachate storage tank as designed is appropriate.

4. The revised sheets submitted to your office reflect the planned revisions to the leachate storage tank construction plans and will be the basis of a change order to the existing construction contract with the leachate storage tank contractor. We acknowledge that other sheets from the construction plans will also be affected by the planned revisions. However, those sheets have not been revised at this time, and the sheets that were revised will be sufficient to execute the change order with the contractor and control construction. All of the sheets in the construction plans will be revised to reflect actual as built conditions. These record drawings will be submitted to your office at the completion of construction.

5. Detail "J" on Sheet S-2 of the revised construction plans shows reinforcing steel layout for the drain penetrations in the secondary containment slab.

6. Structural calculations for the both the leachate storage tank and secondary containment area will be delivered to your office on November 8, 1995. The title page of these calculations identifies that the design standards used for the tank and containment area were the American Concrete Institute Code ACI350R-89 for Environmental Engineering Concrete Structures.

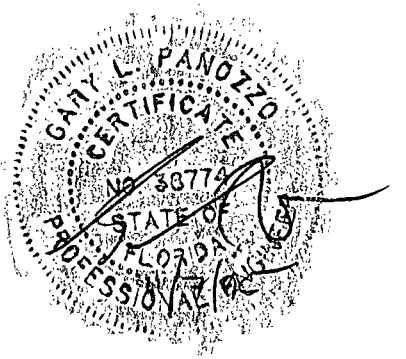
As you have requested in our previous conversations we are submitting three copies of this correspondence to your office and one copy to Mr. Robert Butera - FDEP Tampa. Please do not hesitate to contact me to discuss our application or if you need additional information.

Sincerely,

CH2M HILL

Gary L. Panozzo, P.E.
Geoenvironmental Engineer

LET010.DOC
c: Robert Butera, FDEP Tampa
Gary Kuhl, Citrus County
Susan Metcalfe, Citrus County



SECTION 02200

EARTHWORK

3.03 FILLING AND COMPACTING

Replace excavated material as necessary. Place fill in layers and compact to a minimum density at optimum moisture as required.

3.04 SITE PREPARATION/EARTHWORK

The following recommendations are for overall site preparation work and mechanical densification.

1. The proposed structure area, plus a minimum margin of five (5) feet, shall be cleared and stripped of all surface vegetation, roots, topsoil, and other deleterious material.

2. Additional fill required below the proposed structures may be placed in thin (12 inch maximum uncompacted thickness) level lifts. Each lift of fill and all footing and slab-on-grade support soils to a depth of at least three (3) feet shall be compacted to a minimum of 95 percent of the modified Proctor (ASTM D-1557) maximum dry density. In-place density tests shall be performed during construction even if tests had been performed during placement of the fill soil. The N-values recorded in the borings showed that the relative density of the fill was inconsistent. All proposed sources of structural fill shall be approved by PSI prior to placement. Non-organic sands which have less than 15 percent fines passing a No. 200 sieve will generally be acceptable to use as fill.

3. Prior to beginning the compaction process, moisture contents within the proposed fill soils shall be controlled to within three (3) percent of the modified Proctor optimum moisture content.

4. Site grading shall promote positive surface water outfall away from foundation areas.

5. The Contractor shall insure that the Project Engineer has ample notice to provide on-site observations and testing of the compaction and fill operations so that compliance with the recommendations above can be documented.

Professional Service Industries, Inc.
Jammal & Associates Division

February 24, 1995
Project No. 767-55014

TO: Berryman & Henigar, Inc.
1414 S.W. Martin Luther King Avenue
Ocala, Florida 34474

Attention: Mr. David Brittain, P.E.

SUBJECT: Foundation Recommendations Revision
Proposed Leachate Storage Tank
Citrus County Landfill
Citrus County, Florida

Dear Mr. Brittain:

As per the February 23, 1995, telephone conversation, the Portland cement concrete floor slab for the proposed leachate tank may be placed at the ground surface after completion of site preparation as discussed in the Geotechnical Engineering Study (PSI Project No. 767-55014, Report No. 1). With the containment structure slab abutting the tank slab, the potential for shear failure at the tank slab edges is not expected to be significant.

PSI appreciates the opportunity to provide services on this project and trusts that the information herein is sufficient for your immediate needs. Should you have any questions or if PSI may be of further service, please do not hesitate to contact the undersigned.

Respectfully,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Philip W. Kremp, P.E.
Project Engineer

David J. Rathbun, P.E.
Branch Manager
FL Registration No. 40494

PWK/DJR;kw

CH2M HILL
Engineers
Planners
Economists
Scientists

November 8, 1995

130308.AO.80

Kim B. Ford, P.E.
Solid Waste Section
Florida Department of Environmental Protection
3804 Coconut Palm Drive
Tampa, FL 33619

Dear Mr. Ford:

Subject: Citrus County Central Landfill
Leachate Storage Tank
Permit No.: SC09-272928

The purpose of this correspondence is to provide additional information to your office regarding Citrus County's request for a leachate storage tank construction permit. This additional information is intended to supplement the correspondence from Ms. Susan Metcalfe to your office dated October 23, 1995. The information follows in the order in which it was discussed during our telephone conversation on November 8, 1995.

1. A sign will be erected at the leachate storage tank truck load out area with instructions on transferring leachate to tanker trucks. The proposed sign is depicted in Figure 1.

2. The purpose of the diffusers is to prevent leachate stored in the tank from going septic. The diffusers will be operated manually. There is no pre-existing schedule of operations for the diffusers. Operation of the diffusers will depend on visual inspection of the leachate by landfill personnel. If the leachate is being stored in the tank for periods of time that are causing the leachate to go septic, than the diffusers will be operated.

3. The design capacity of the leachate storage tank is 250,000 gallons.

4. As part of the weekly tank inspection required by Rule 62-701.400(6)(c)(9), FAC, all construction joints will be visually inspected. Any joint sealant which is

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damaged shall be repaired immediately by landfill personnel with replacement sealant. A stock of replacement sealant will be kept on site by landfill personnel.

Also enclosed with this correspondence are the tank and containment area structural calculations referenced in CH2M HILL's letter dated November 6, 1995. As you have requested in our previous conversations we are submitting three copies of this correspondence to your office and one copy to Mr. Robert Butera - FDEP Tampa. Please do not hesitate to contact me to discuss our application or if you need additional information.

Sincerely,

CH2M HILL

Gary L. Panozzo, P.E.
Geoenvironmental Engineer

LET010.DOC
c: Robert Butera, FDEP Tampa
Gary Kuhl, Citrus County
Susan Metcalfe, Citrus County

LEACHATE LOADING INSTRUCTIONS

1. CLOSE STORMWATER RUNOFF VALVE
2. OPEN LEACHATE DRAIN VALVE
3. CONNECT HOSING TO LOADOUT CAMLOCK FITTING AND TRANSFER LEACHATE TO TRUCK
4. WHEN TRANSFER IS COMPLETED, DISCONNECT HOSING AND INSPECT TRUCK PAD FOR ANY SPILLAGE
5. IF SPILLAGE IS PRESENT, CONTACT LANDFILL OPERATIONS PERSONNEL IMMEDIATELY
6. IF NO SPILLAGE IS PRESENT, CLOSE LEACHATE DRAIN VALVE AND OPEN STORMWATER RUNOFF VALVE

FIGURE 1
Truck Loading Station Signage

CH2MHILL®

STRUCTURAL CALCULATIONS

for

CITRUS COUNTY

CENTRAL LANDFILL

for the

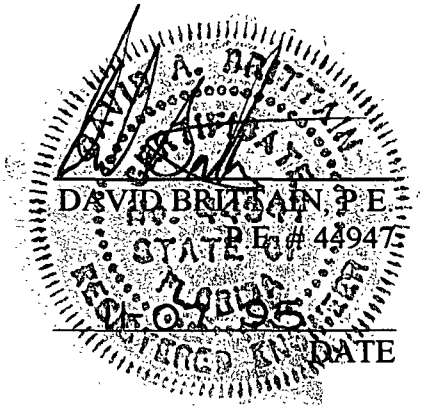
LEACHATE STORAGE TANK

Prepared in accordance with:

American Concrete Institute's
ACI 350R-89
Environmental Engineering Concrete Structures

Prepared by:

BERRYMAN & HENIGAR



Berryman & Henigar
BSI Consultants, Inc • Henigar & Ray, Inc

Henigar & Ray

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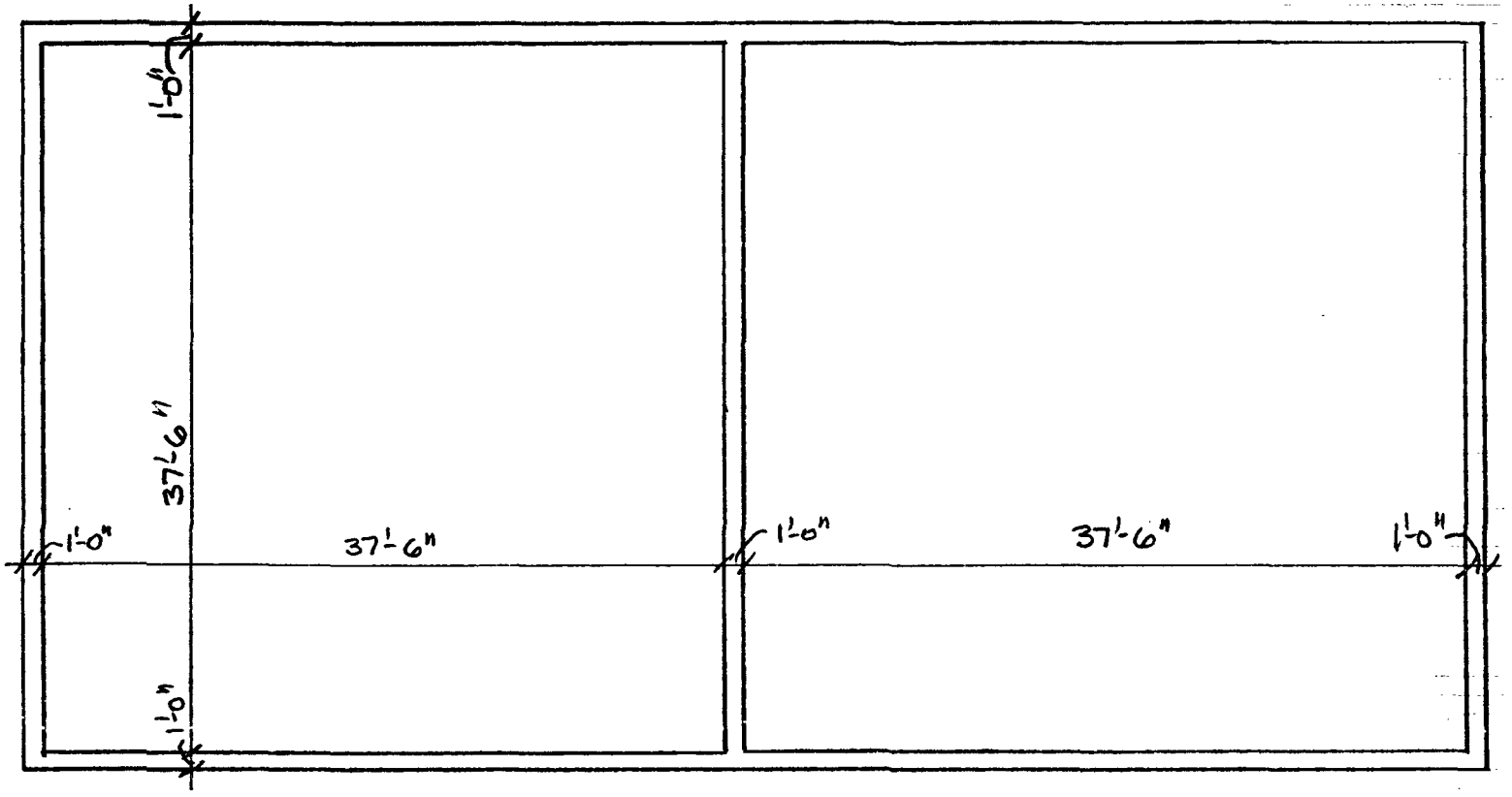
checked by: _____ date: _____ sheet no. 1

PROJECT: CITRUS CO. LEACH. TANK

LEACHATE TANK

CELL WALLS



HIGH WATER @ 12'-4" + 1'-6" ⇒ 13'-10 TO TOP OF WALL

$a = 12.33$; $b/a = c/a = 3.0$

W/ FIXED BASE ⇒ PCA TABLE 3

$wa^3/1000 = 62.5(12.33)^3 = 117.25^{KF}$

$wa^2/1000 = 62.5(12.33)^2 = 9.51^{K}$

Henigar & Ray

made by: DAB date: 01-13-96 job no. 45085
checked by: _____ date: _____ sheet no. 2

PROJECT: CITRUS CO. LEACH TANK

WALL MOMENTS (K-FT)						
x/a	y=0		y=b/4		y=b/2	
	Mx	My	Mx	My	Mx	My
0	0	+2.93	0	+1.64	0	-9.61
1/4	+1.17	+2.23	+0.82	+1.52	-1.64	-8.32
1/2	+0.59	+1.17	+0.94	+1.17	-1.29	-6.45
3/4	-3.87	-0.47	-2.11	0	-0.70	-3.28
1	-14.77	-2.93	-10.79	-2.11	0	0
WALL REINF. REQ'D (IN²/FT) (CALCULATED) (12" WALL d_x = 9.6875" d_y = 9.6625")						
0	0	.1612	0	.0896	0	.5487
1/4	.0596	.1222	.0417	.0830	.0837	.4715
1/2	.0300	.0638	.0479	.0638	.0658	.3617
3/4	.1996	.0255	.1080	0	.0356	.1808
1	.8050	.1612	.5758	.1156	0	0
REINF. SIZE & SPC'G						
0	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5 @ 6½ #6 @ 9½ #7 @ 12
1/4	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5 @ 7½ #6 @ 11 #7 @ 12
1/2	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5 @ 10 #6 @ 12
3/4	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5@12
1	#5 @ 4½ #6 @ 6½ #7 @ 8½	#5@12*	#5 @ 6½ #6 @ 9 #7 @ 12	#5@12*	#5@12*	#5@12

.293
.3916 ×.75=.279

* MIN REINF #4 @ 12" (A_s = .20 in²/FT) @ ρ_{MIN} = .0033 ⇒ $A_{s_{MIN_x}}$ = .3875 in² ⇒ #5@9½"
$A_{s_{MIN_y}}$ = .3625 in² ⇒ #5@10"

y = b/4 = 38.5/4 = 9.625' ≈ 9'-7½"

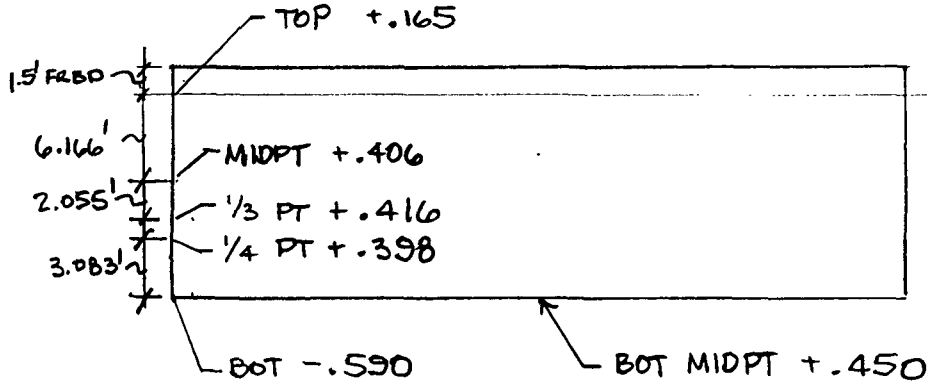
a/4 = 3.083' ≈ 3'-1" ; a/2 = 6'-2" ; 3a/4 = 9'-3"

Henigar & Ray

made by: DAB date: 1-16-95 job no. 45085
checked by: _____ date: _____ sheet no. 3

PROJECT: CITRUS CO. LEACH. TANK

SHEAR



TRY SHEAR FRICTION W/ #4 @ 12"

$A_{vf} = .20 \Rightarrow \phi V_n = 0.85(.20)(60)(1.4(1.0)) = 14.28^K/FT$

$\Rightarrow$ ALLOWABLE SERVICE LOAD SHEAR

$= \frac{14.28}{1.7(1.65)} = 5.09^K/F$

$\Rightarrow$ ALLOWABLE COEFF $= \frac{5.09(1000)}{(62.5)(12.33)^2} = .535$

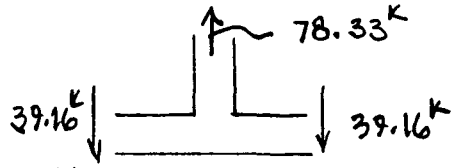
@ -.590 COEFF $\Rightarrow$ INWARD SHEAR SAY #4@12" OK
(#4 @ 10.89")

TOTAL SHEAR

TOT. BOT. SHEAR = $.286 w a^2 b = .286(62.5)(12.33)^2(38.5)/1000 = 104.68^K$

TOT. SIDE SHEAR = $.107 w a^2 b = 39.16^K$

@ CENTER WALL

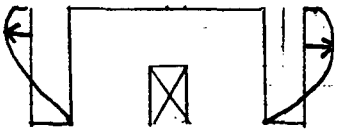


$A_{s_{TEN.\,REQ'D}} = \frac{78.33(1.65)(1.7)}{.9(60)} = 4.07\ in^2 \Rightarrow 21-\#4$

CHECK CENTER WALL FOR TRANSMITTING SHEAR TO BOT. SLAB

@ TOT. SHEAR LOAD $\Rightarrow 78.33^K \times 1.65 \times 1.7 = 219.7^K$

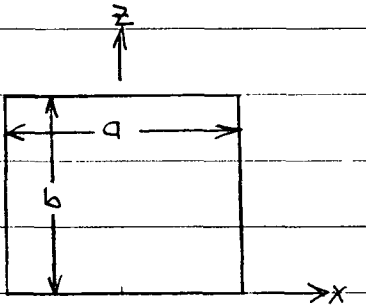
TRY #4 @ 12" EF. $\phi V_n = .85(.4)(60)(1.0(1.0)) = 20.4^K/F$
$\times 15.75' = 321.3^K > 219.7^K$ ∴ OK



BASE SLAB

From Roark's Formulas for Stress and Strain, pg 464, Table 26

Rectangular Plate, all edges fixed, uniform load over entire area.



$a/b = 1$

$\beta_1 = 0.3078$

$\beta_2 = 0.1386$

$\text{Max } \sigma = \frac{-\beta_1 q b^2}{t^2}$ (center of long edge) where q = unit lateral pressure

$b = 37.5'$

t = thickness of plate

Volume of concrete $= 3\left(13\frac{10}{12}'\right)(1')(37.5') + 2(78')\left(13\frac{10}{12}'\right)(1') + \left(\frac{16}{12}'\right)(80')(39.5')$

$= 7928\ ft^3$

Dead weight of tank $= (0.150\ k/ft^3)(7928\ ft^3) = 1189\ k$ — 551^k @ WALLS ONLY

Uniform pressure on soil $= \frac{1189\ k}{(39.5')(80')} = 0.3763\ ksf$ — .176 @ WALLS ONLY

$\text{Max } \sigma = -\frac{(0.3078)(0.3763\ ksf)(37.5\ ft)^2}{\left(\frac{16}{12}\ ft\right)^2} = -91.62\ ksf$ — 42.93 ksf @ WALLS ONLY

$\sigma(S) = \text{Moment}$ where S = section modulus $= \frac{bh^2}{6}$ $b = 1'$ (strip), h = thickness of slab =

$S = 0.2963\ ft^3$

$M = (0.2963)(91.62\ ksf) = 27.15^{KF}$ — 12.72^{KF} @ WALLS ONLY

CITRUS COUNTY LANDFILL KAC 1-16-95 45085

Sht. 2

$M_u = 1.3(1.7)(27.15^{KF}) = 60^{KF}$ $M_u = 28.11^{KF}$ @ WALLS ONLY

$d = 16 - 3 - 0.5 = 12.5''$

$R_n = \frac{M_u}{\phi b d^2} = \frac{60^{KF}(12)(1000)}{0.9(12)(12.5)^2} = 426.7 \text{ psi}$ .200 ksi @ WALLS ONLY

$\rho = \frac{1}{20.17}\left(1 - \sqrt{\frac{1 - 2(20.17)(426.7)}{60000}}\right) = 0.007711$ .00345 @ WALLS ONLY

$\rho_{min} = \frac{200}{60000} = 0.003333$

$\rho_{max} = 0.75\rho_b = 0.75\left[\frac{0.85(3500)}{60000}(0.85)\left(\frac{87000}{87000+60000}\right)\right] = 0.01871$

$\rho_{req'd} = 0.007711 \Rightarrow$ OK

$A_s = 0.007711(12)(12.5) = 1.16 \text{ in}^2 \Rightarrow$ #8's @ 8" / #7's @ 6" / #6's @ 4½" $A_s = .52^{IN^2/FT}$ @ WALLS ONLY $\Rightarrow$ #7 @ 13½"

$\frac{1.16 \text{ in}^2}{12 \text{ in}} = \frac{0.60 \text{ in}^2}{X \text{ in}} = 6.21''$

CCLF KAC 1-16-95 45085

Sht 3

REV. DAB 11-07-95

$$Max\sigma = \frac{\beta_2 q b^2}{t^2} \quad (At\ center)$$

$$= \frac{(0.1386)(0.3763\,ksf)(37.5\,ft)^2}{(16/12\,ft)^2} = 41.26\ ksf$$

$$\sigma(S) = Moment = (0.2963\,ft^3)(41.26\,ksf) = 12.23^{KF}$$

$$M_u = 1.3(1.7)(12.23^{KF}) = 27.03^{KF}$$

$$R_n = \frac{27.03^{KF}(12)(1000)}{0.9(12)(12.5)^2} = 192.2\ psi$$

$$\rho_{reqd} = \frac{1}{20.17}\left(1 - \sqrt{1 - \frac{2(20.17)(192.2)}{60000}}\right) = 0.003314\,in^2 \geq A_{min} = 0.003$$

#7's @ 12" E.W. E.F

$$A_s = (0.003333)(12)(12.5) = 0.500\,in^2 \rightarrow \#6's\ @\ 10.5"$$

#5's @ 7"

CHECK SLAB FOR WALL MOMENT

$M = 14.77^{KF} \Rightarrow M_u = 32.64^{KF} \Rightarrow R_u = .232\ ksi \Rightarrow \rho_{reqd} = .00403 \Rightarrow A_{s\,reqd} = .60\,in^2 \Rightarrow$ #7@12"

USE #7 @ 12" E.W. TOP & BOT.

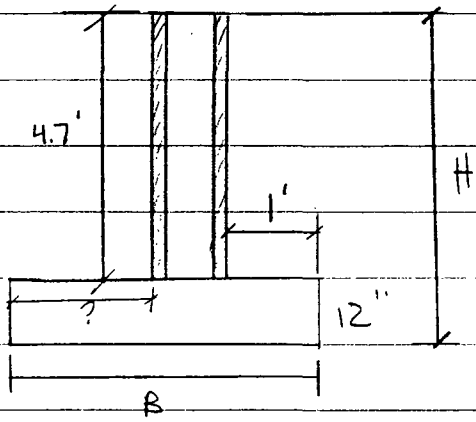
@ SECONDARY CONTAINMENT SLAB UNDER TANK SLAB USE SAME THICKNESS & REINFORCING. CONSERVATIVE BY INSPECTION.

CCLF LEACHATE TANK
SECONDARY CONTAINMENT

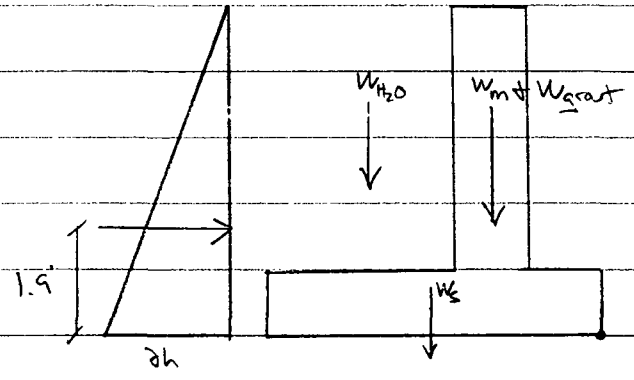
KAC 2-7-95 45085

Sht 1

Retaining Wall



let B = 0.7(H) = 0.7(5.7') = 3.99 ≈ 4'



OVERTURNING

$W = \frac{1}{2}\gamma h(5.7)(1ft) = \frac{1}{2}(62.4)(5.7)(5.7)(1) = 1013.7$ lb Arm = 1.9 ft

Overturning moment = 1013.7 lb (1.9 ft) = 1926.03 lb-ft ↻

RESISTING

$W_{H_2O} = (62.4\ lb/ft^3)(2ft)(4.7ft)(1ft) = 586.56$ lb w/Arm = 3 ft

$W_{slab} = (150\ lb/ft^3)(4ft)(1ft)(1ft) = 600$ lb w/Arm = 2 ft

$W_{masonry} = (51\ lb/ft^2)(4.7ft)(1ft) = 239.7$ lb w/Arm = 1.5 ft

$W_{grout} = (130\ lb/ft^3)(5in)(7.825in)(1/144)(4.7ft) = 167.1$ lb w/Arm = 1.5 ft

Resisting Moment = (586.56)(3) + 600(2) + 239.7(1.5) + 167.1(1.5) =

= 3569.9 lb-ft ↺

F.S. OVERTURNING = $\frac{3570 \text{ lb-ft}}{1926.0 \text{ lb-ft}} = 1.854 > 1.5$ OK

SLIDING

Driving force = 1613.7 lb

Resisting force = μ (Σ Vertical forces) → 1593.4

= 0.45 (586.56 + 600 + 239.7 + 167.1 lb) = 717.0 lb

↓ 192.8

728.6 lb

the soil to the right of the slab above the heel OK

SOIL PRESSURE

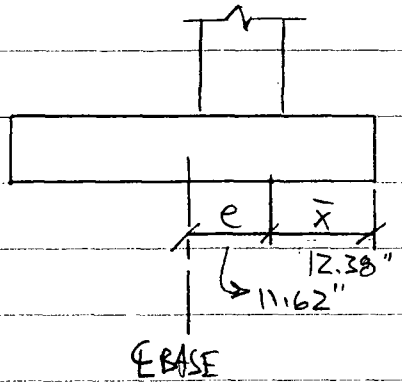
$q = \frac{R_v}{B}\left(1 - \frac{6e}{B}\right)$

$M_R - M_O = R_v(\bar{x})$

$3569.9 - 1926.0 = (1593.4)(\bar{x})$

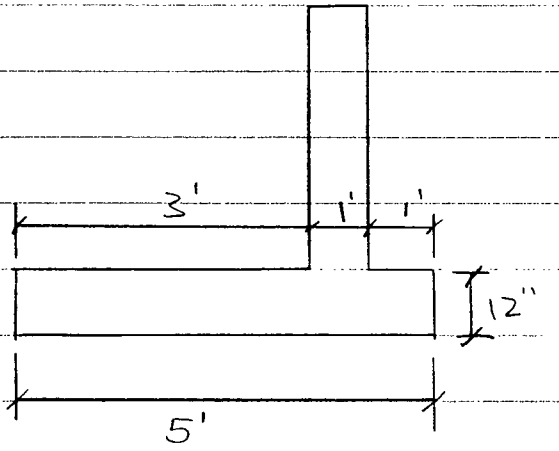
$\bar{x} = 1.0317 \text{ ft} = 12.38''$

$e = 24'' - 12.38'' = 11.62''$



$B/6 = \frac{4(12)}{6} = 8.00$ $\quad e = 11.62'' > B/6 = 8.00'' \Rightarrow$ wheel is negative

Revised Resisting Moments



	Arm
$W_{H_2O} = (62.4)(3)(4.7)(1) = 879.84$ lb	3.5'
$W_{base} = (150\ lb/ft^3)(1)(5)(1) = 750$ lb	2.5'
$W_{wall} = (110\ lb/ft^3)(4.7)(1)(1) = 517$ lb	1.5'
2146.8 lb $= R_v$	

Resisting Moment = 5729.9 lb-ft

F.S. OVERTURNING $= \frac{5729.9\ lb\text{-}ft}{1926.015\ ft} = 2.98 \rightarrow$ OK

SOIL PRESSURE

$M_R - M_O = R_v(x) \Rightarrow x = \frac{(5729.9 - 1926)}{2146.8} = 1.77'$

$e = 2.5' - 1.77' = 0.73'$

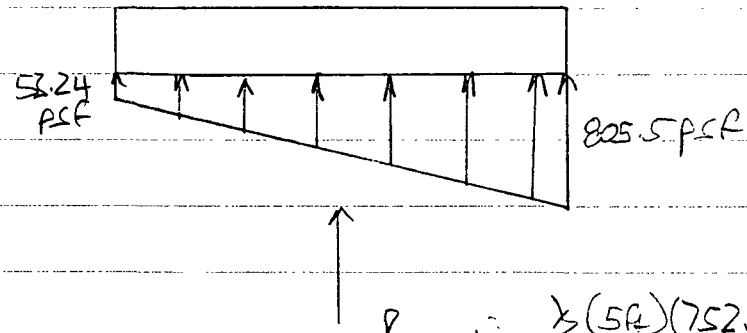
$B/6 = 5/6 = 0.83$

$e < B/6 \Rightarrow$ no uplift

q_{acting}

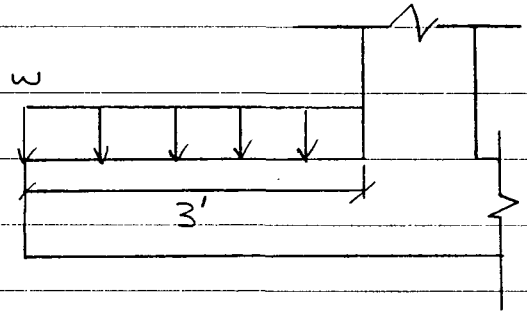
$$q_{toe} = \frac{R_v}{B}\left(1 \pm \frac{6e}{B}\right) = \frac{2146.8}{5}\left(1 + \frac{6(0.72)}{5}\right) = 805.5 \text{ psf}$$

$$q_{heel} \longrightarrow = \frac{2146.8}{5}\left(1 - \frac{6(0.73)}{5}\right) = 53.24 \text{ psf}$$



$$R_{ground} = \tfrac{1}{2}(5\text{ft})(752.3\text{Y}1\text{ft}) + 53.24(5)(1)$$
$$= 2146.95$$

HEEL DESIGN



$$w = (62.4\ ^{lb}/_{ft^3})(4.7\text{ft}) = 293.28 \text{ psf}\,(1\text{ft}) = 293.28\ ^{lb}/_{ft}$$
$$_{H_2O}$$

$$w_{conc} = (150\ ^{lb}/_{ft^3})(1')(1') = 150\ ^{lb}/_{ft}$$

$$w = 443.28\ ^{lb}/_{ft} \rightarrow w_u = 1.4(443.28) = 620.59\ ^{lb}/_{ft}$$

$$M_u = \frac{w_u \ell^2}{2} = \frac{(620.59)(3)^2}{2} = 2792.7 \text{ lb-ft}$$

$V_u = 620.59\ ^{lb}/_{ft}(3\ ft) = 1861.8\ lb$

$\phi V_c = \phi(2\sqrt{f'_c})bd$

$= 0.85(2\sqrt{3000\ psi})(12in)(9) = 10{,}056\ lb$

$\phi V_c > 2V_u \rightarrow$ no shear reinforcement required

$M_u = 2927.7\ lb\text{-}ft$

$R_u = \frac{M_u}{\phi b d^2} = \frac{(2927.7\ lb\text{-}ft)(12)}{(0.90)(12in)(9in)^2} = 38.308\ psi$

$\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_u}{f_y}}\right)$ where $m = \frac{f_y}{0.85f'_c} = \frac{60000}{0.85(3000)}$

$= 23.529$

$\rho = \frac{1}{23.529}\left(1 - \sqrt{1 - \frac{2(23.529)(38.308)}{60000}}\right) = 0.0006433$

$\frac{200}{f_y} = \rho_{min} = 0.003333$

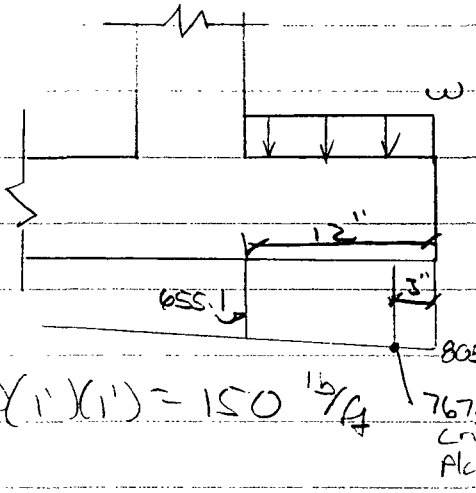
$\frac{1}{3}(0.0006433) = 0.0008577 \rightarrow A_s = (0.0008577)(12)(9) = 0.09263$

#4@25.91" → #4@24" Flexural Steel

#4@9" Temp./Shrinkage Steel

per ACI 318-
7.12.2.2

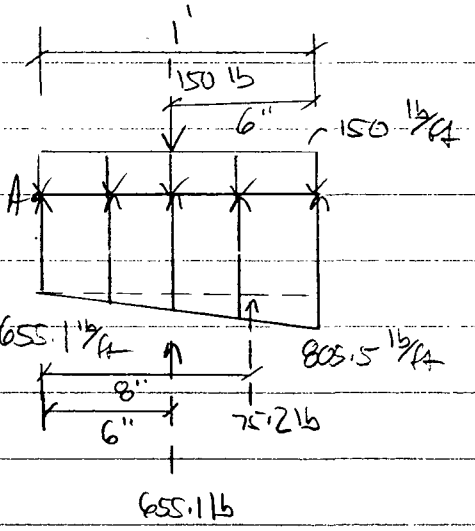
TOE DESIGN



$w_{conc} = (150\ lb/ft^3)(1')(1') = 150\ lb/ft$

slope = $\frac{752.26\ psf}{5\ ft}$ = 150.45 psf/ft

$V_u = 1.7\left(\frac{805.5+767.9}{2} - 150\right)\left(\frac{3}{12}ft\right)(1ft) = 276.60\ lb$



$\Sigma M_A\ (+\circlearrowleft) \rightarrow \left[752.1\text{lb}(8") + 655.1\text{lb}(6") - 150\text{lb}(6")\right] \frac{1}{12} = 302.68\ lb\text{-}ft$

$1.7(302.68\ lb/ft) = 514.56\ lb\text{-}ft = M_u$

$R_u = \frac{m_u}{\phi b d^2} = \frac{514.56(12)}{0.9(12)(9)^2} = 7.058\ psi$

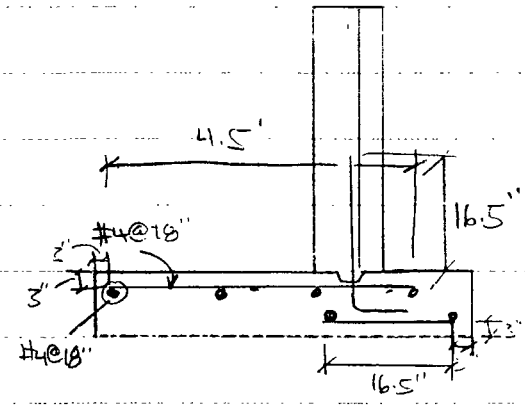
$A = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_u}{f_y}}\right) = 0.0001178 \rightarrow A_s = 0.01272\ in^2\ @\ 88"$

$\phi V_c = 0.85(2)\sqrt{3000}(12)(9) = 10056$ lb

$V_u = 270.60$ lb

$\phi V_c > V_u \Rightarrow$ no shear reinforcement required

use temperature steel



development length for #4 bars →

$$l_{db} = \frac{0.04(0.20in^2)(60000)}{\sqrt{3000}} = 8.7636''$$

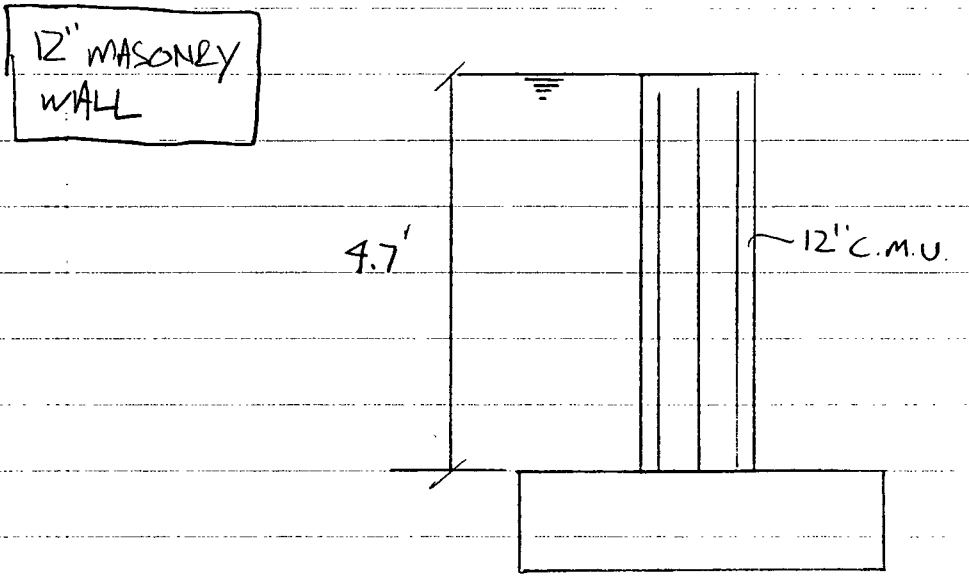
$$l_d = 8.7636(1.0)(0.8) = 7.0109''$$

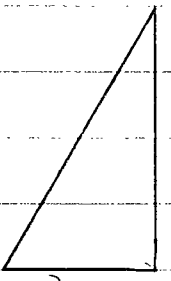
$$\frac{0.03 d_b f_y}{\sqrt{f'_c}} - \text{lower limit} = 16.43''$$

Controls

CCLF LEACHATE TANK — KAC — 2-7-95 — 45085

SECONDARY CONTAINMENT — sht. 1





$P = \gamma h = (62.4\ ^{lb}/_{ft^3})(4.7\ ft) = 293.28\ psf$

Total Force on wall = $293.28\ psf\left(\frac{1}{2}\right)(4.7\ ft)(1\ ft) = 689.21\ lb$

Moment at base of stem = $\frac{(689.21\ lb)(4.7\ ft)}{3} = 1079.8\ lb\text{-}ft$

$d = \frac{11.625}{2} = 5.8125\ in$

A_s should approximately be #5@40"

Assume $j = 0.95$

$$A_s = \frac{M}{f_s j d} = \frac{1079.8(12)}{(24000psi)(0.95)(5.8125)} = 0.097775 in^2$$

$$\rho = \frac{A_s}{bd} = \frac{0.097775 in^2}{(12)(5.8125)} = 0.0014018$$

$$k = \sqrt{(\rho n)^2 + 2\rho n} - \rho n$$

$$n = \frac{E_s}{E_c} = \frac{29 \times 10^6 psi}{1.5 \times 10^6 psi} = 19.333$$

$k = 0.20728$

$$j = 1 - \frac{k}{3} = 1 - \frac{0.20728}{3} = 0.93091 \rightarrow \text{new } A_s = 0.099780$$

↳ using new $j \Rightarrow A_s = \frac{M}{f_s j d}$

Check steel stress $\rightarrow f_s = \frac{M}{A_s j d} = \frac{1079.8(12)}{(0.099780)(0.93091)(5.8125)}$

$= 24005 \rightarrow$ OK

Check masonry stress $\rightarrow f_b = \frac{2M}{kjbd^2} = \frac{2(1079.8)(12)}{(0.20728)(0.93091)(12)(5.8125)^2}$

$= 331.27 < \frac{1500psi}{3} = 500psi \rightarrow$ OK

$A_s = 0.099780$ / ft width $\rightarrow$ #5@ 37.28" $\Rightarrow$ #5@32" ← USE

#6@ 53" $\Rightarrow$ #6@48"

#4@ 24" $\Rightarrow$ #4@24"

$kd = 0.20728(5.8125) = 1.205 < 1.5"$ shell thickness

SECONDARY CONTAINMENT SLAB (NOT UNDER TANK)

HYDROSTATIC LOAD WILL BE RESISTED BY SUBGRADE. SO ESSENTIALLY MINIMUM SLAB REQ'D STRUCTURALLY. AT 4.7 FT HYDROSTATIC HEAD ⇒ 4.7(62.4) = 293 PSF UNIFORM LOAD. FOR INDUST. SLAB. WITH 400-500 PSF LOADING CRSI RECOMMENDS 6" SLAB. (SEE ATTACHED) WITH 6×6 6/6 WELDED WIRE FABRIC WHICH HAS $0.06^{IN^2}/FT$ AREA OF REINFORCING.

@ SHRINKAGE & TEMPERATURE STEEL w/ 6" SLAB

$\rho = .0018 \Rightarrow A_{s\,REQ'D} = .1296^{IN^2}/FT \Rightarrow$ #3@10", #4@18", #5@28"

TO KEEP ANY CRACKS TIGHT PROVIDE ADDT'L REINF.

@ $\rho = .004 \Rightarrow A_{s\,REQ'D} = .288^{IN^2}/FT \Rightarrow$ #3@4½", #4@8", #5@13"

USE #5 @ 12" E.W.

FROM 1003
CRSI

SLABS ON GROUND

For any slab on the ground, adequate preparation of subgrade for drainage and compaction is of prime importance. Dowelled expansion joints and weakened plane contraction joints should be carefully located, including expansion joints at all walls, columns, open pits, etc.

The design of slabs on the ground to distribute concentrated or uniform loads involves the elastic properties of the subsoil and the slab itself.* An analysis can be made but is quite involved. Slabs for the very lightest occupancy should be not less than 4" thick, and slabs for other occupancies may be empirically selected, the following being about minimum and sometimes less than required (ACI 10.5.3) for supported slabs:—

Occupancy **	Min. Slab Thickness	Reinforcement ‡
Sub-slabs under other slabs	2"	None
Domestic or light commercial (loaded less than 100 psf)	4"	One layer 6 x 6 10/10 welded wire fabric, minimum for ideal conditions; 6 x 6 8/8 for average conditions.
Commercial—institutional—barns (loaded 100-200 psf)	5"	One layer 6 x 6 8/8 welded wire fabric or one layer 6 x 6 6/6.
Industrial (loaded not over 400-500 psf) and pavements for industrial plants, gas stations, and garages	6"	One layer 6 x 6 6/6 welded wire fabric or one layer 6 x 6 4/4.
Industrial (loaded 600-800 psf) and heavy pavements for industrial plants, gas stations, and garages	7"	Two layers 6 x 6 6/6 welded wire fabric or two layers 6 x 6 4/4
Industrial (loaded 1500 psf) †	8"	Two mats of bars (one top, one bottom), each of #4 bars @ 12" c/c, each way
Industrial (loaded 2500 psf) †	9"	Two mats of bars (one top, one bottom), each of #5 bars @ 12" c/c, each way
Industrial (loaded 3000-3500 psf) †	10"	Two mats of bars (one top, one bottom), each of #5 bars @ 8" to 12" c/c, each way

* "Concrete Floors on Ground" and "Concrete Airport Pavement," Portland Cement Association, 1952; "Design of Concrete Floors on Ground for Warehouse Loadings," ACI Jour., Aug. 1957; "Design, Construction, and Performance of Slabs-on-Grade for an Industry," ACI Jour., Nov. 1978; and "Pavements and Slabs-on-Grade with Structurally Active Reinforcement," ACI Jour., Dec. 1978.

** For loads in excess of, say, 500 psf, use at least 3000 psi quality controlled concrete, and investigate subsoil conditions with extra care. Fill material and compaction should be equivalent to ordinary highway practice. If laboratory control of compaction is available, the load capacities can be increased in the ratio of the actual compaction coefficient, k, to 100.

† For loads in excess of, say, 1500 psf the subsoil conditions should be investigated with extra care and subbase should provide $k \geq 200$.

‡ Place first layer 2 in. below top of slab; second layer, 2 in. above bottom of slab.

Note: Floors on expansive subsoils require two-way slab-and-beam designs. See 1968 BRAB Report 33—Criteria for Selection and Design of Residential Slabs-on-Ground.

STRUCTURAL CALCULATIONS

for

CITRUS COUNTY

CENTRAL LANDFILL

for the

LEACHATE STORAGE TANK

Prepared by:

BERRYMAN & HENIGAR

DAVID BRITTAIN, P.E.
FPE #44947
DATE

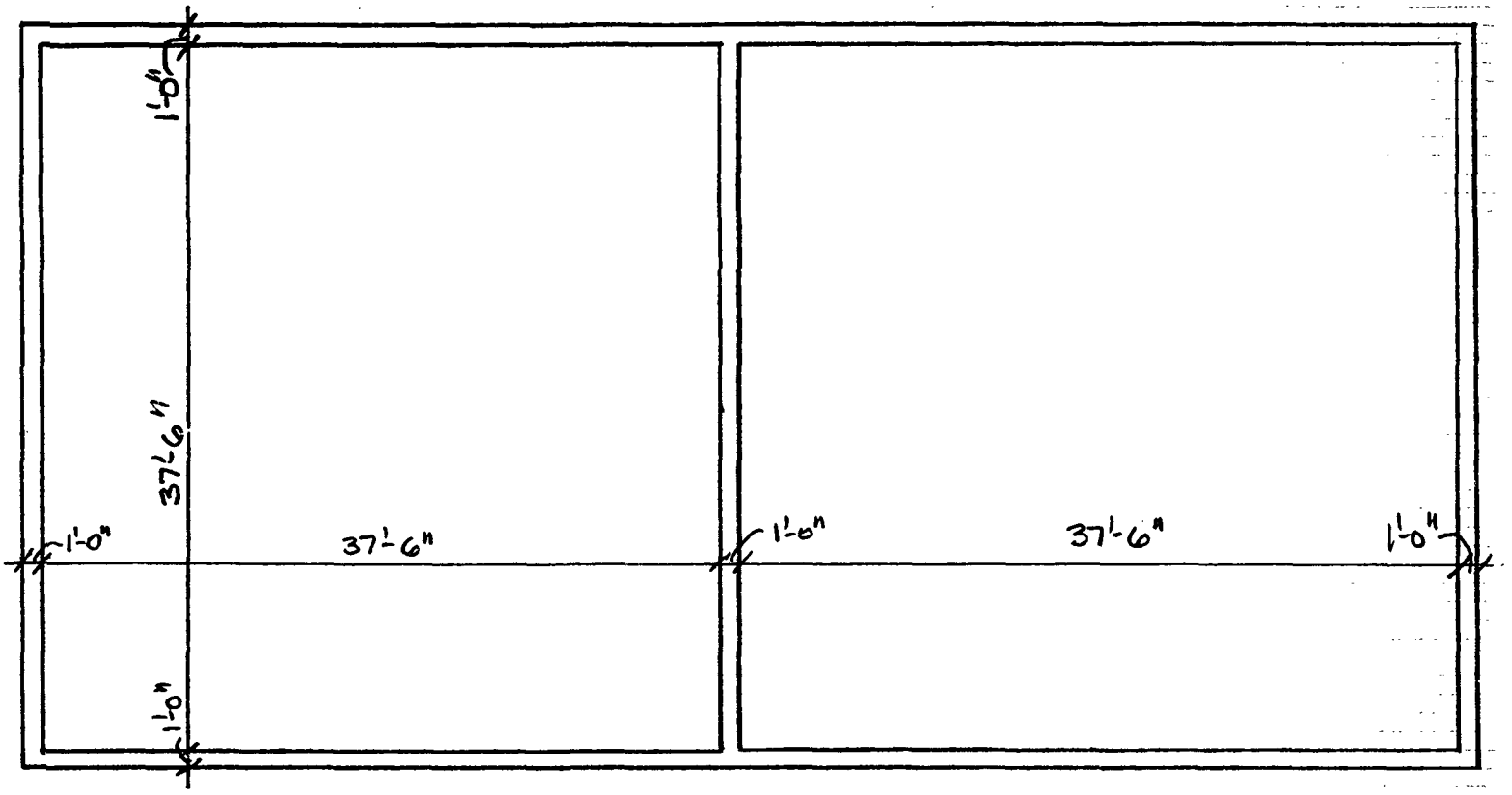
Henigar & Ray

made by: DAB date: 01-13-95 job no. 45085
checked by: _____ date: _____ sheet no. 1

PROJECT: CITRUS CO. LEACH. TANK

LEACHATE TANK

CELL WALLS



HIGH WATER @ 12'-4" + 1'-6" ⇒ 13'-10 TO TOP OF WALL

$a = 12.33$; $b/a = c/a = 3.0$

W/ FIXED BASE ⇒ PCA TABLE 3

$wa^3/1000 = 62.5(12.33)^3 = 117.25^{KF}$

$wa^2/1000 = 62.5(12.33)^2 = 9.51^{K}$

Henigar & Ray

made by: DAB date: 01-13-96 job no. 45085
checked by: _____ date: _____ sheet no. 2

PROJECT: CITRUS CO. LEACH TANK

WALL MOMENTS (K-FT)						
x/a	y=0		y=b/4		y=b/2	
	Mx	My	Mx	My	Mx	My
0	0	+2.93	0	+1.64	0	-9.61
1/4	+1.17	+2.23	+0.82	+1.52	-1.64	-8.32
1/2	+0.59	+1.17	+0.94	+1.17	-1.29	-6.45
3/4	-3.87	-0.47	-2.11	0	-0.70	-3.28
1	-14.77	-2.93	-10.79	-2.11	0	0
WALL REINF. REQ'D (CALCULATED) IN^2/FT (12" WALL d_x = 9.6875" d_y = 9.0625")						
0	0	.1612	0	.0896	0	.5487
1/4	.0596	.1222	.0417	.0830	.0837	.4715
1/2	.0300	.0638	.0479	.0638	.0658	.3617
3/4	.1996	.0255	.1080	0	.0356	.1808
1	.8050	.1612	.5758	.1156	0	0
REINF. SIZE & SPC'G						
0	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5@6½ / #6@5½ / #7@12
1/4	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5@7½ / #6@11 / #7@12
1/2	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5@10 / #6@12
3/4	#5@12*	#5@12*	#5@12*	#5@12*	#5@12*	#5@12
1	#5@4½ / #6@6½ / #7@8½	#5@12*	#5@6½ / #6@9 / #7@12	#5@12*	#5@12*	#5@12

.2937
.3916 x.75

* MIN REINF #4 @ 12" (A_s = .20 in^2/FT) @ ρ_{MIN} = .0333 ⇒ $A_{s_{MIN_x}}$ = .3875 in^2 ⇒ #5@9½"

$A_{s_{MIN_y}}$ = .3625 in^2 ⇒ #5@10"

y = b/4 = 38.5/4 = 9.625' ≈ 9'-7½"

a/4 = 3.083' ≈ 3'-1" ; a/2 = 6'-2" ; 3a/4 = 9'-3"

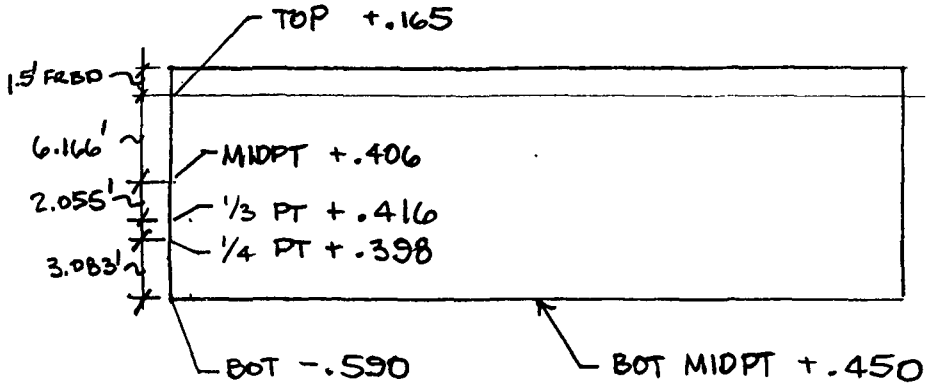
.372
x.75=.279

Henigar & Ray

made by: DAB date: 1-16-95 job no. 45085
checked by: _____ date: _____ sheet no. 3

PROJECT: CITRUS CO. LEACH. TANK

SHEAR



TRY SHEAR FRICTION W/ #4 @ 12"

$A_{vf} = .20 \Rightarrow \phi V_n = 0.85(.20)(60)(1.4(1.0)) = 14.28^K/FT$

$\Rightarrow$ ALLOWABLE SERVICE LOAD SHEAR

$= \frac{14.28}{1.7(1.65)} = 5.09^K/F$

$\Rightarrow$ ALLOWABLE COEFF $= \frac{5.09(1000)}{(62.5)(12.33)^2} = .535$

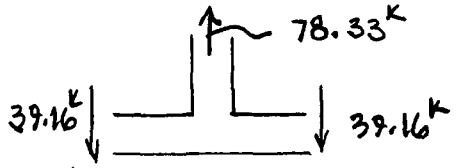
@ -.590 COEFF $\Rightarrow$ INWARD SHEAR SAY #4@12" OK
(#4 @ 10.89")

TOTAL SHEAR

TOT. BOT. SHEAR $= .286 w a^2 b = .286(62.5)(12.33)^2(38.5)/1000 = 104.68^K$

TOT. SIDE SHEAR $= .107 w a^2 b = 39.16^K$

@ CENTER WALL



$A_{s_{TEN.\ REQ'D}} = \frac{78.33(1.65)(1.7)}{.9(60)} = 4.07\ in^2 \Rightarrow 21-\#4$

CHECK CENTER WALL FOR TRANSMITTING SHEAR TO BOT. SLAB

@TOT. SHEAR LOAD $\Rightarrow 78.33^K \times 1.65 \times 1.7 = 219.7^K$

TRY #4 @ 12" EF. $\phi V_n = .85(.4)(60)(1.0(1.0)) = 20.4^K/F$
$\times 15.75' = 321.3^K > 219.7^K$ ∴ OK