

Fort Worth Central City Preliminary Design

Civil/Structural Preliminary Design

Draft Environmental Impact Statement

Appendix C

May 2005

Volume V – Stability Analysis Storm Water Pump Station







STABILITY ANALYSES FOR STORM WATER PUMP STATION

Contents: Stability Analyses for Storm Water Pump Station

Volume V

Section 1	Index of Excel Spreadsheets
Section 2	Center of Gravity (CG) Spreadsheet for Various Components
Section 3	Counterfort
Section 4	Storm Water Pump Station Stability Analyses Load Case 1 – During Construction Load Case 2 – During Construction Maintenance Load Case 3 - Normal Load Case 4 - Normal
Section 5	Bearing Pressure
Section 6	Cell Formulas for Excel Spreadsheets Counterfort Stability Bearing Pressure Analysis
Section 7	Design of Steel H – Piles (Manual Calculations)
Section 8	Seismic Load Case Check



Section 1 Index of Excel Spreadsheets



STABILITY ANALYSES STORM WATER PUMP STATION

Index of Excel Spreadsheets:

Center of Gravity of various structure components: File name: CG of building side walls File name: CG of conc Upper side wall File name: CG of conc Lower side wall File name: CG of conc Upper counterfort File name: CG of conc Lower counterfort

Counterfort: File name: Counterfort.xls

Stability: File name: PS Stability.xls Tab name: Load Case 1 (Construction Case - Unusual) Tab name: Load Case 2 (Maintenance or Construction Case - Unusual) Tab name: Load Case 3 (Normal (drained soil) - Usual) Tab name: Load Case 4 (Normal (undrained soil) - Usual)

Bearing Pressure: File name: PS Bearing Pressure.xls

Section 2 Center of Gravity (CG) Spreadsheets for Various Components



Storm Water Pump Station

Center of Gravity (CG) spreadsheets for various components:

- 1. Building Side Walls (File: CG of building side walls.xls)
- 2. Upper Concrete Side Wall (File: CG of conc Upper side wall.xls)
- 3. Lower Concrete Side Wall (File: CG of conc Lower side wall.xls)
- 4. Upper Counterfort for Lateral Force (File: CG of conc Upper counterfort.xls)
- 5. Lower Counterfort for Lateral Force (File: CG of conc Lower counterfort.xls)

CDM	Project:	TRWD-FWCC Storm Water P.S.	Engineer:	EJB	Project #
8140 Walnut Hill Lane			Date:	18-Jan	42275
Dallas, TX 75231	Subject:	Building side walls	Checker:		Page:
tel. (214) 346-2800			Date:		





CDM	Project:	TRWD-FWCC Storm Water P.S.	Engineer:	EJB	Project #
8140 Walnut Hill Lane			Date:	18-Jan	42275
Dallas, TX 75231	Subject:	Upper Conc Side Wall	Checker:		Page:
tel. (214) 346-2800			Date:		

Node	s Coordinat	es	Abo	out Centroidal A
	X	Y	φ =	-42.716 deg
1	0.000	0.000	A =	892.50 ft^2
2	0.000	26.000	(Xcg =	15.630 ft)
3	30.000	33.500	Ycg =	14.954 ft
4	30.000	0.000	lxo =	67912.8 ft^4
5	0.000	0.000	lyo =	66583.0 ft^4
6	0.000	0.000	lxyo =	8322.9 ft^4
7	0.000	0.000		
8	0.000	0.000		Section Propertie
9	0.000	0.000	φ =	-42.716 deg
10	0.000	0.000	lxp =	75597.3 ft^4
11	0.000	0.000	lyp =	58898.5 ft^4
12	0.000	0.000	lxyp =	0.0 ft^4
13	0.000	0.000	J =	134495.8 ft^4
14	0.000	0.000	L	
15	0.000	0.000	40	
16	0.000	0.000		
17	0.000	0.000	35	
18	0.000	0.000		
19	0.000	0.000	30	
20	0.000	0.000		
21	0.000	0.000		
22			20 -	
23				
24			20 -	
25				
26			15	
27				
28			10	
29				
30			5	
31				
32				
33			-5 0	5 10

Section Properties								
About Centroidal Axis Parallel to Original Axis								
φ =	-42.716 deg	X-dim =	30 ft					
A =	892.50 ft^2	Y-dim =	33.5 ft					
Xcg =	15.630 ft	Sx(top) =	3661.8 ft^3					
Ycg =	14.954 ft	Sx(bot) =	4541.5 ft^3					
lxo =	67912.8 ft^4	Sy(left) =	4259.9 ft^3					
lyo =	66583.0 ft^4	Sy(right)=	4633.6 ft^3					
lxyo =	8322.9 ft^4							

	Section Properties	About Princip	al Axis
φ =	-42.716 deg	Sxp(top) =	3234.2 ft^3
lxp =	75597.3 ft^4	Sxp(bot) =	3501.5 ft^3
lyp =	58898.5 ft^4	Syp(left) =	3103.6 ft^3
lxyp =	0.0 ft^4	Syp(right)=	2845.1 ft^3
J =	134495.8 ft^4		



Toe

CDM	Project:	TRWD-FWCC Storm Water P.S.	Engineer:	EJB	Project #
8140 Walnut Hill Lane			Date:	18-Jan	42275
Dallas, TX 75231	Subject:	Lower Conc Side Wall	Checker:		Page:
tel. (214) 346-2800			Date:		

Abo	Section F ut Centroidal Axis	Properties Parallel to Ori	ginal Axis
φ =	-13.679 deg	X-dim =	30 ft
A =	1102.50 ft^2	Y-dim =	41 ft
Xcg =	15.578 ft	Sx(top) =	5651.2 ft^3
Ycg =	18.457 ft	Sx(bot) =	6902.3 ft^3
lxo =	127394.5 ft^4	Sy(left) =	5284.2 ft^3
lyo =	82318.9 ft^4	Sy(right)=	5708.0 ft^3
lxyo =	11661.8 ft^4		
S	ection Properties	About Princip	al Axis
φ =	-13.679 deg	Sxp(top) =	5144.7 ft^3
Ixp =	130232.9 ft^4	Sxp(bot) =	6024.4 ft^3
lyp =	79480.5 ft^4	Syp(left) =	4306.2 ft/3
Ixyp =	0.0 ft/4	Syp(right)=	4324.9 103
J =	209713.4 104		······
45			
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35		_	
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25			
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5			
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70	e		

Nodes Coordinates						
	X	Y				
1	0.000	0.000				
2	0.000	32.500				
3	30.000	41.000				
4	30.000	0.000				
5	0.000	0.000				
6	0.000	0.000				
7	0.000	0.000				
8	0.000	0.000				
9	0.000	0.000				
10	0.000	0.000				
11	0.000	0.000				
12	0.000	0.000				
13	0.000	0.000				
14	0.000	0.000				
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17	0.000	0.000				
18	0.000	0.000				
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CDM	Project:	TRWD-FWCC Storm Water P.S.	Engineer:	EJB	Project #
8140 Walnut Hill Lane			Date:	18-Jan	42275
Dallas, TX 75231	Subject:	Upper Counterfort for lateral force	Checker:		Page:
tel. (214) 346-2800			Date:		

Units: ft

1713-16				Section I	Properties		4
Node	es Coordinate	es	Abou	It Centroidal Axis	Parallel to Ori	ginal Axis	
	X	Y	φ =	20.155 deg	X-dim =	10 ft	
1	0.000	0.000	A =	110.00 ft^2	Y-dim =	19 ft	
2	0.000	19.000	Xcg =	3.788 ft	Sx(top) =	173.9 ft^3	
3	10.000	3.000	(Ycg =	6.470 ft	Sx(bot) =	336.8 ft^3	
4	10.000	0.000	lxo =	2179.1 ft^4	Sy(left) =	199.3 ft^3	
5	0.000	0.000	lyo =	755.1 ft^4	Sy(right)=	121.5 ft^3	
6	0.000	0.000	lxyo =	-604.0 ft^4			
7	0.000	0.000					_
8	0.000	0.000	S	ection Properties	About Principa	al Axis	
9	0.000	0.000	φ =	20.155 deg	Sxp(top) =	183.7 ft^3	
0	0.000	0.000	lxp =	2400.8 ft^4	Sxp(bot) =	292.3 ft^3	
1	0.000	0.000	lyp =	533.3 ft^4	Syp(left) =	92.2 ft^3	
2	0.000	0.000	lxyp =	0.0 ft^4	Syp(right)=	115.0 ft^3	
3	0.000	0.000	J =	2934.1 ft^4		- 11994mmya	
4	0.000	0.000					
5	0.000	0.000	T				
6	0.000	0.000					
7	0.000	0.000		18	• • •	1	
8	0.000	0.000	1	16	: : ·	1	
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31							V
32				<u> </u>	i		
33			-10 -5	0	5 10	15 20)

Use Area (110 ft2) for lateral force

CDM	Project:	TRWD-FWCC Storm Water P.S.	Engineer:	EJB	Project #
8140 Walnut Hill Lane			Date:	18-Jan	42275
Dallas, TX 75231	Subject:	Lower Counterfort for lateral force	Checker:		Page:
tel. (214) 346-2800			Date:		

A L	Section F	Properties	ninal Avic	
ADO	10.803 deg	Y-dim -	95 ft	
$\psi =$	152 00 ft/2	V-dim -	29 ft	
	-3 /6/ ft	Sx(ton) =	366 6 ft^3	
	9 760 ft	Sx(bot) =	722.6 ft^3	
	7052 9 ft^4	$S_{V}(left) =$	147 7 ft^3	
	891 6 ft^4	Sy(right) =	257 4 ft^3	
iyo –	1220 1 ft^4	Gy(right)-	20/11/11/0	
17,90		L		_i
S	ection Properties	About Principa	nl Axis	
φ =	-10.803 deg	Sxp(top) =	372.7 ft^3	
Ixp =	7285.8 ft^4	Sxp(bot) =	679.7 ft^3	
lyp =	658.8 ft^4	Syp(left) =	141.3 ft^3	
lxyp =	0.0 ft^4	Syp(right)=	125.9 ft^3	
J =	7944.6 ft^4			
		20 15 10		monent arm
5 -20	-15 -10 -	5 0	5 10 15	9.70

Node	es Coordina	ites
<u>. Alla lla contra la contra con</u>	X	Y
1	0.000	0.000
2	-9.500	0.000
3	-9.500	3.000
4	0.000	29.000
5	0.000	0.000
6	0.000	0.000
7	0.000	0.000
8	0.000	0.000
9	0.000	0.000
10	0.000	0.000
11	0.000	0.000
12	0.000	0.000
13	0.000	0.000
14	0.000	0.000
15	0.000	0.000
16	0.000	0.000
17	0.000	0.000
18	0.000	0.000
19	0.000	0.000
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Section 3 Counterfort



Storm Water Pump Station Counterfort

(File: Counterfort.xls)

PROJECT:		TRWD - STORM	WATER PU	MP STATION			
PROJECT	NO:	2521-42275-PRS	TR.PS				
DESIGNED	DBY:	E. BJORKLUND			DATE:	1/17/2005	
CHECKED	BY:				DATE:		
UPPER CO	DUNTERFO	ORT					
E.F.P.=	70	psf / ft of depth					
Depth =	38	ft from grade to up	oper counte	rfort base			
Centroid =	6.47	ft from centroid to	upper coun	terfort base - S	SEE CG SP	READSHEET	
				<u>u</u>			
	ground to	pressure at	Section	Total Force	Centroid	Moment Arm	
Section	centroid	centroid	Area	on Area	Location	about upper slab	Moment
Trapezoid	31.53	2207	110	242781	6.47	6.47	1570793
LOWER C	OUNTERF	ORT					
E.F.P.=	70	psf / ft of depth					
Depth =	45.5	ft from grade to ba	ase				
Centroid =	9.76	ft from centroid to	base - SEE	CG SPREAD	SHEET		
	ground to	pressure at	Section	Total Force	Centroid	Moment Arm	
Section	centroid	centroid	Area	on Area	Location	about lower slab	Moment
Trapezoid	35.74	2502	152	380273.6	9.76	9.76	3711470
				ann worm			
UPPER CO	OUNTERFO	ORT					
E.F.P.=	105	psf / ft of depth					
Depth =	38	ft from grade to up	oper counte	rfort base			
Centroid =	6.47	ft from centroid to	upper coun	terfort base - S	SEE CG SP	READSHEET	
-							
	ground to	pressure at	Section	Total Force	Centroid	Moment Arm	
Section	centroid	centroid	Area	on Area	Location	about upper slab	Moment
Trapezoid	31.53	3311	110	364171.5	6.47	6.47	2356190
			0				
LOWER C	OUNTERF	ORT					
E.F.P.=	105	psf / ft of depth					
Depth =	45.5	ft from grade to ba	ase				
Centroid =	9.76	ft from centroid to	base - SEE	CG SPREAD	SHEET		
	around to	pressure at	Section	Total Force	Centroid	Moment Arm	
Section	centroid	centroid	Area	on Area	Location	about lower slab	Moment
Trapezoid	35.74	3753	152	570410.4	9.76	9.76	5567206

Section 4 Storm Water Pump Station Stability Analysis



Storm Water Pump Station Stability

(File: PS Stability.xls with Tabs for Load Cases)

Load Case 1 - During Construction

- 1. Dead loads + equipment.
- 2. No live loads, no soil, no water.

PROJECT:	TRWD - STORM WATER PUMP STATION												
PROJECT NO:	2521-42275-PRSTR.PS										-		· · · · · · · · · · · · · · · · · · ·
DESIGNED BY:	E. BJORKLUND	DATE:	1/18/	2005									
CHECKED BY:		DATE:				· · ·	-						
								-			-		
STABILITY													
Load Condition 1 - D	During Construction												
(dead loads + equip	ment loads, no live loads		- (Total or Avg	Total or Avg	Total or Avg				Moment Arm	Resisting	Overturning
no soil, no water)		Unit fo	rce	Quantity	Length	Width	Height	Removed	portions	Weight	to Toe	Moment	Moment
					(ft)	(ft)	(ft)			(lbs)	(ft)	(lbs-ft)	(lbs-ft)
VERTICAL													
	It wt conc on metal deck/bar joists at 6' spacing/			_									
Roof D.L.	lighting/etc. minus roof openings	50) psf		23	53		4 x 36sf =	144	53,750	20	1,075,000	
Building Walls	12" CMU at 20' height minus vent openings	80) psf		53		20	16 x 16 sf =	256	64,320	9.25	594,960	
	12" CMU at 16.5' avg height minus vent openings	80) psf	2	20		16.5	5 x 16 sf =	80	40,000	19.1	764,000	
- ·	12" CMU at 11.5' height minus vent openings	80) psf		53		11.5	8 x 16 sf =	128	38,520	30.75	1,184,490	
Top Floor Slab	18" thick	225	5 psf		21.5	50				241,875	19.25	4,656,094	
Top Floor Beams	2 beams at 2.5' x 1.5' each (beneath slab)	563	B pLF	2	50					56,300	16	900,800	
	Upper exterior end wall - 24" avg thickness												
C.I.P. Walls	EI 548.0 to 513.0 =35' height	300) psf		39.25		35			412,125	31.17	12,845,936	
	Upper exterior side wall - 24" avg thickness												
	EI (546.5-538.0) to 513.0 =29.25' avg height	300) psf		30		29.25			263,250	15.63	4,114,598	
	Lower (deep) exterior end wall - 27" avg thickness												
	EI 548.0 to 505.5 =42.5' height	338	8 psf		15.08		42.5			216,624	31.17	6,752,176	
	Lower (deep) exterior side wall - 27" avg thickness												
	El (546.5-538.0) to 505.5 =36.75' avg height	338	psf		30		36.75			372,645	15.58	5,805,809	
	channel divider wall 18" thick												
	El 538.0 to 513.0 =25' height	225	psf	3	30		25			506,250	15	7,593,750	
	Lower channel divider (side) wall 18" thick	225	5 psf		30		7.5			50,625	15	759,375	
	Upper counterfort (SOUTH) 24" thick	300	psf	1	5		16			24,000	1	24,000	
	Upper counterfort (MID) 24" thick	300	psf	1	5		16			24,000	16	384,000	
	Upper counterfort (NORTH) 24" thick	300	psf	1	5		16			24,000	31	744,000	
	Lower counterfort (SOUTH) 24" thick	300	psf	1	4.75		23			32,775	1	32,775	
	Lower counterfort (MID) 24" thick	300	psf	1	4.75		23			32,775	16	524,400	
	Lower counterfort (NORTH) 24" thick	300	psf	1	4.75		23			32,775	31	1,016,025	
Base Slab	36" thick	450	psf		75	51				1,721,250	25.5	43,891,875	
Pumps	Upper vertical pumps	30500	lbs	3						91,500	25.5	2,333,250	
	Lower vertical pump	34500	lbs	1						34,500	25.5	879,750	
	at Upper channels w/ 11.33' width each												
Trash Racks	using 55 ~ 5/8"x6" steel bars x 25' long @ 2.5"c/c	319	lbs	165						52,635	4.25	223,699	
	at Lower channel w/ 11.33' width												
	using 55 ~ 5/8"x8" steel bars x 32' long @ 2.5"c/c	545	lbs	55						29,975	4.25	127,394	
										4,416,469	22.01	97,228,155	

PS Stability.xls Load Case 1

Storm Water Pump Station

Stability

(File: PS Stability.xls with Tabs for Load Cases)

Load Case 2 - During Construction or Maintanence

1. Dead loads.

- 2. No equipment, no live loads, low water (empty inlet).
- 3. Undrained (saturated) backfill.
- 4. Uplift

PROJECT:	TRWD - STORM WATER PUMP STATION		ļ					ļ							
PROJECT NO:	2521-42275-PRSTR.PS		1/10/	2005									-		
CHECKED BY:		DATE:	1/10/2	1005											
STABILITY															
Load Condition 2 - D	uring Construction/Maintenance		l		T	Tatal an Arra			l				5		
saturated backfill + I	pment, no live loads ow water/empty + unlift)	Linit fo	rce	Quantity	Length	I otal or Avg	l otal or Avg Height	Removed	d nortions	Weight/force	Eorce	Moment Arm	Moment	Overturning	
				Quantity	(ft)	(ft)	(ft)	<u>nemove</u>		(lbs)	(lbs)	(ft)	(lbs-ft)	(lbs-ft)	
VERTICAL							(-7			((12.0)			(.20.17)	
	It wt conc on metal deck/bar joists at 6' spacing/														
Roof D.L.	lighting/etc. minus roof openings	50	psf		23	53		4 x 36sf =	144	53,750		20	1,075,000		
Dullully walls	12" CMU at 20 height minus vent openings	80	psi	2	20		20	16 X 16 SI =	250	64,320		9.25	594,960		
	12" CMU at 11.5' height minus vent openings	80	psf	<u> </u>	53		11.5	$8 \times 16 \text{ sf} =$	128	38,520		30.75	1.184.490		
Top Floor Slab	18" thick	225	psf		21.5	50				241,875		19.25	4,656,094		
Top Floor Beams	2 beams at 2.5' x 1.5' each (beneath slab)	563	pLF	2	50					56,300		16	900,800		
	Upper exterior end wall - 24" avg thickness	000			20.05		05			410.105		01.17	10.045.000		
U.I.F. Walls	Upper exterior side wall - 24" avg thickness	300	psi		39.25		35			412,125		31.17	12,845,936		
	El (546.5-538.0) to 513.0 =29.25' avg height	300	psf		30		29.25			263,250		15.63	4,114,598		
	Lower (deep) exterior end wall - 27" avg thickness														
	EI 548.0 to 505.5 =42.5' height	338	psf		15.08		42.5			216,624		31.17	6,752,176		
	Lower (deep) exterior side wall - 27" avg thickness	220	nef		30		36.75			272 645		15 59	E 905 900		
	channel divider wall 18" thick	000	hai				30.75			372,040		10.00	5,605,609		
	EI 538.0 to 513.0 =25' height	225	psf	3	30		25			506,250		15	7,593,750		
	Lower channel divider (side) wall 18" thick	225	psf		30		7.5			50,625		15	759,375		
	Upper counterfort (SOUTH) 24" thick	300	psf	1	5		16			24,000		1	24,000		
·····	Upper counterfort (MID) 24" thick	300	pst	1	5		16			24,000		16	384,000		
	Lower counterfort (SOUTH) 24" thick	300	psi	1	4.75		23			32,775		1	32 775	* 	
	Lower counterfort (MID) 24" thick	300	psf	1	4.75		23			32,775		16	524,400		
	Lower counterfort (NORTH) 24" thick	300	psf	1	4.75		23			32,775		31	1,016,025		
Base Slab	36" thick	450	psf		75	51				1,721,250		25.5	43,891,875		
Soil weight	(vertical volume, no cone action)	130	ncf		51 17	18.5	35			4 307 235		41 75	179 827 051		
	on Lower Heel Footing	100	por		01.17	10.0	00			4,007,200		41.70	170,027,001		
	(vertical volume, no cone action)	130	pcf		23.83	18	42.5			2,369,894		42	99,535,527		
	on Upper Counterfort Footing														
	(Vertical volume, no cone action)	130	pct	1	30	10	29.25			1,140,750		15	17,111,250		
	(vertical volume, no cone action)	130	ncf	1	30	95	36 75			1 361 588		15	20 423 813		
										13,387,325		30.67	410,561,703		
LATERAL															
.															
Saturated soil forces	on Upper end wall area.														Assumes moment-arm
	includes effects from 260 pst surface surcharge	105	ncf		51 17		38				3 879 198	12.65		10 097 368	of LIPPER foundation
	on Upper end wall counterfort area only	100	por		01.17		00				0,070,100	12.00		43,007,000	
	Pressure of 105 psf is per CTWALL results,														Assumes moment-arm
(see COUNTERFORT	includes effects from 260 psf surface surcharge.				and count of a										rotation about bottom
spreadsheet)	Unit force shown is at centroid of counterfort area.	3311	pcf			10	11				364,210	6.47		2,356,439	of UPPER foundation
													V I I I I I I I I I I I I I I I I I I I		
	on Lower end wall area.														Assumes moment-arm
	includes effects from 260 psf surface surcharge	105	ncf		23.83		45.5				2 590 038	15 15		39 242 961	of LOWER foundation
- 0-	on Lower end wall counterfort area only.		F *:											00,212,001	
	Pressure of 105 psf is per CTWALL results,														Assumes moment-arm
(see COUNTERFORT	includes effects from 260 psf surface surcharge.			Î											rotation about bottom
spreadsheet)	Unit force shown is at centroid of counterfort area.	3753	pcf		· · · · ·	9.5	16				570456	9.76		5,567,651	of LOWER foundation
											7,403,902	13.00		96,254,418	
	at Linner channel at inlat/her servers (LIDDED TOE)														
	High Groundwater/Saturated soil up to Elev. 513.0														
Uplift	bottom of base at $510.0 = 3.0$ ft head (uniform load)	62.4	pcf		49.5	51	3			-472,586		25.5		12.050.953	
	at Upper channel at end wall (UPPER HEEL):														
	High Groundwater/Saturated soil up to Elev. 548.0,	L. L													
	bottom of base at 513.0 = 35.0 ft head (triangular load)	62.4	pcf		49.5	51	35			-2,756,754		34.02		93,784,771	
	at Lower channel at inlet/bar screen (LOWER TOE):							And out to have							
	High Groundwater/Saturated soil up to Elev. 505.5,				05.00	-				A / · · · · ·		~ ~ ~			
	oution of base at 502.5 = 3.0 ft head (uniform load)	62.4	pct		25.33	51	3			-241,831		25.5		6,166,680	
	High Groundwater/Saturated soil up to Flev 548.0														
	bottom of base at $505.5 = 42.5$ ft head (triangular load)	62.4	pcf		25.33	51	42.5			-1,712.967		34.02		58,275,123	
			·					·		-5,184,138	ŀ	32.85		170,277,527	
·····										,				,	
										8,203,187	7,403,902		410,561,703	266,531,945	



PS Stability.xls Load Case 2

Storm Water Pump Station Stability

(File: PS Stability.xls with Tabs for Load Cases)

Load Case 3 – Normal

1. Dead loads + equipment + live loads.

2. Maximum design water surface (full inlet) at Elevation 527.3.

- 3. Drained (dry) backfill.
- 4. No uplift.

PROJECT:	TRWD - STORM WATER PUMP STATION														
PROJECT NO:	2521-42275-PRSTR.PS														
DESIGNED BY:	E. BJORKLUND	DATE: 1	/18/200	5											
CHECKED BY:		DATE:							_						
STABILITY						-									
Load Condition 3 - N	lormal	-													
(dead loads + equipr	nent + live loads.				Total or Avg	Total or Avg	Total or Avg		1		Lateral	Moment Arm	Resisting	Overturning	
unsaturated backfill	+ max. water surface. no uplift)	Unit forc	e Q	uantitv	Lenath	Width	Height	Remove	d portions	Weight/force	Force	to Toe	Moment	Moment	
					(ft)	(ft)	(ft)			(lbs)	(lbs)	(ft)	(lbs-ft)	(lbs-ft)	
VERTICAL					<u></u>	, <i>'</i>				1			, , , , , , , , , , , , , , , , , , ,		1
Roof L.L.		55 p	osf		23	53				67,045		20	1,340,900		
	It wt conc on metal deck/bar joists at 6' spacing/														
Roof D.L.	lighting/etc. minus roof openings	50 p	osf		23	53		4 x 36sf =	144	53,750		20	1,075,000	v	
Building Walls	12" CMU at 20' height minus vent openings	80 p	ost		53		20	16 x 16 st :	= 256	64,320		9.25	594,960		
	12" CMU at 11.5' height minus vent openings	80 p	ost	2	20		10.5	5 X 16 SI =	100	40,000		19.1	1 194 400		
Ton Floor Slab L 1	12 CMO at 11.5 height minus vent openings	200 p	vol i		20	50	11.5	0 X 10 51 =	120	200,000		20	4,000,000		
Top Floor Slab	18" thick	225 0	sf		21.5	50				241.875		19.25	4,000,000		
Top Floor Beams	2 beams at 2.5' x 1.5' each (beneath slab)	563 p		2	50					56,300		16	900.800		
	Upper exterior end wall - 24" avg thickness					1									-
C.I.P. Walls	EI 548.0 to 513.0 =35' height	300 p	sf		39.25		35			412,125		31.17	12,845,936		
	Upper exterior side wall - 24" avg thickness														
	El (546.5-538.0) to 513.0 =29.25' avg height	300 p	sf		30		29.25	ļ		263,250		15.63	4,114,598		
	Lower (deep) exterior end wall - 27" avg thickness														
	EI 548.0 to 505.5 =42.5' height	338 p	st		15.08		42.5			216,624		31.17	6,752,176		
	Lower (deep) exterior side wall - 2/" avg thickness	000 -	.4		80		00.75			070.045		45.50	5 005 000		
	EI (546.5-538.0) to 505.5 =36.75 avg neight	338 p	ST		30		36.75			372,645		15.58	5,805,809		
	El 538 0 to 513 0 $-25'$ beight	225 n	of	3	30		25			506 250		15	7 502 750		
	Lower channel divider (side) wall 18" thick	225 p	sf	5	30		75			50 625		15	759,375		
	Upper counterfort (SOUTH) 24" thick	300 p	sf	1	5		16	-		24,000		1	24,000		-
	Upper counterfort (MID) 24" thick	300 p	sf	1	5		16			24.000		16	384.000		
	Upper counterfort (NORTH) 24" thick	300 p	sf	1	5		16			24,000		31	744,000	·····•	
	Lower counterfort (SOUTH) 24" thick	300 p	sf	1	4.75		23			32,775		1	32,775		
	Lower counterfort (MID) 24" thick	300 p	sf	1	4.75		23			32,775		16	524,400		
	Lower counterfort (NORTH) 24" thick	300 p	sf	1	4.75		23			32,775		31	1,016,025		
Base Slab	36" thick	450 p	sf	-	75	51				1,721,250		25.5	43,891,875		
Pumps	Upper vertical pumps	30500 10)S	3				· · · · · · · · · · · · · · · · · · ·		91,500		25.5	2,333,250		
170070414_0	Lower venical pump	34500 10)S							34,500		25.5	879,750		
Trash Backs	using 55 - 5/8"v6" steel bars v 25' long @ 2 5"c/c	310 lb		165						50 625		4.95	222 600		
114010	at Lower channel w/ 11 33' width	3191	15	105						52,035		4.20	223,099		
	using 55 ~ $5/8$ "x8" steel bars x 32' long @ 2 5"c/c	545 lb	ns l	55						29 975		4 25	127 394		
	on Upper Heel Footing												127,001		
Soil weight	(vertical volume, no cone action)	100 p	cf		51.17	18.5	35			3,313,258		41.75	138,328,501		
	on Lower Heel Footing														
	(vertical volume, no cone action)	100 p	cf		23.83	18	42.5			1,822,995		42	76,565,790		
	on Upper Counterfort Footing														
	(vertical volume, no cone action)	100 p	cf	1	30	10	29.25			877,500		15	13,162,500		
	on Lower Counterfort Footing	100	- 1	.			00.75			1 0 17 075		15	15 710 005		
	(Vertical Volume, no cone action)	100 p	CT	1	30	9.5	36.75			1,047,375		15	15,710,625		
Water weight	Elev. 527 3 to 513 0 base - 14 3' water height	62.4 p	of	3	20	11 33	14.2			000 000		15	12 649 491		and a second
Water weight	Lower channels w/ Max Design Flow WS Fley.	02.4 p				11.55	14.5		· · · · · · · ·	303,033		15	13,040,401		
	Elev. 527.3 to 505.5 base = 21.8' water height	62.4 p	cf	1	30	11.33	21.8			462,373		15	6,935,592		
										12,996,118		28.23	366 920 543		
LATERAL										12,000,110			000,020,010		
Unsaturated soil forces	on Upper end wall area.														Assumes mo
	Pressure of 70 psf is per CTWALL results,														rotation abou
	includes effects from 260 psf surface surcharge	70 p	cf		51.17		38				2,586,132	12.65		32,724,912	of UPPER fo
	on Upper end wall counterfort area only.														
	Pressure of 70 psf is per CTWALL results,									Annual Inc.					Assumes mo
(see COUNTERFORT	includes effects from 260 psf surface surcharge.														rotation abou
spreadsheet)	Unit force shown is at centroid of counterfort area.	2207 pc	of			10	11				242,770	6.47		1,570,722	of UPPER fo
				T											
	on Lower end wall area.														Assumes mo
	Pressure of 70 psf is per CTWALL results,		and the second		10 June 10 Jun										rotation abou
	includes effects from 260 psf surface surcharge	70 pc	of		23.83		45.5				1,726,692	15.15		26,161,974	of LOWER for
	on Lower end wall counterfort area only.														
	Pressure of 70 psf is per CTWALL results,				ro Manada										Assumes mo
(see COUNTERFORT	Includes effects from 260 psf surface surcharge.														rotation abou
spreausneet)	Unit force shown is at centroid of counterfort area.	2502 pc				9.5	16			 	380,304	9.76		3,711,767	or LOWER fo
											4,935,898	13.00		64,169,375	
										10,000,110	1 005 000		266 000 540	64 100 075	
		1								12,990,118	4,935,898		300,920,543	04,109,375	

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Storm Water Pump Station

Stability

(File: PS Stability.xls with Tabs for Load Cases)

Load Case 4 - Normal

1. Dead loads + equipment.

- 2. No live loads, low water (empty inlet).
- 3. Undrained (saturated) backfill.

4. Uplift

PROJECT:	TRWD - STORM WATER PUMP STATION														
DESIGNED BY:	E. BJORKLUND	DATE:	1/18/	2005											
CHECKED BY:		DATE:			· · ·										
Load Condition 4 - N	ormal									-					
(dead loads + equipn	nent loads, no live loads	-			Total or Avg	Total or Avg	Total or Avg		1		Lateral	Moment Arm	Resisting	Overturning	
saturated backfill + lo	ow water/empty + uplift)	Unit fo	rce	Quantity	Length	Width	Height	Remove	d portions	Weight/force	Force	to Toe	Moment	Moment	
VERTICAL			-		(π)	(#)	(#)			(lbs)	(Ibs)	(ft)	(lbs-ft)	(ibs-ft)	
	It wt conc on metal deck/bar joists at 6' spacing/														
Roof D.L.	lighting/etc. minus roof openings	50	psf		23	53		4 x 36sf =	144	53,750		20	1,075,000		
Building Walls	12" CMU at 20' height minus vent openings	80	pst	2	20		20	16 x 16 st =	256	64,320		9.25	594,960		
	12" CMU at 11.5' height minus vent openings	80	psf		53		11.5	8 x 16 sf =	128	38,520		30.75	1,184,490		
Top Floor Slab	18" thick	225	psf	-	21.5	50				241,875		19.25	4,656,094		
Top Floor Beams	2 beams at 2.5' x 1.5' each (beneath slab)	563	pLF	2	50					56,300		16	900,800		
C.I.P. Walls	El 548.0 to 513.0 =35' height	300	psf		39.25		35			412,125		31.17	12,845,936		
	Upper exterior side wall - 24" avg thickness	000			00		00.05			000.050		45.00	4 4 4 4 5 0 0		
	Lower (deep) exterior end wall - 27" avg thickness	300	psi		30		29.25			263,250		15.63	4,114,598		
	El 548.0 to 505.5 =42.5' height	338	psf		15.08		42.5			216,624		31.17	6,752,176		
	Lower (deep) exterior side wall - 27" avg thickness	000	nof		20		00.75			070 646		15.50	F 905 900		
	channel divider wall 18" thick		psi			<u> </u>	30.75			372,043		10.00	5,005,009		
	El 538.0 to 513.0 =25' height	225	psf	3	30		25			506,250		15	7,593,750		
	Lower channel divider (side) wall 18" thick	225	psf psf	1			7.5		<u>.</u>	50,625		15	759,375		
	Upper counterfort (MID) 24" thick	300	psf	1	5		16			24,000		16	384,000		
	Upper counterfort (NORTH) 24" thick	300	psf	1	5		16			24,000		31	744,000		
	Lower counterfort (SOUTH) 24" thick	300	pst	1	4.75		23			32,775		1	32,775		
	Lower counterfort (NORTH) 24" thick	300	psf	1	4.75		23			32,775		31	1,016,025		
Base Slab	36" thick	450	psf	2	75	51				1,721,250		25.5	43,891,875		
	lower vertical pump	34500	lbs	1						34,500		25.5	2,333,250		
	at Upper channels w/ 11.33' width each														
Trash Hacks	using 55 ~ 5/8"x6" steel bars x 25' long @ 2.5"c/c at Lower channel w/ 11.33' width	319	lbs	165						52,635		4.25	223,699		
	using 55 ~ 5/8"x8" steel bars x 32' long @ 2.5"c/c	545	lbs	55						29,975		4.25	127,394		
Coil woight	on Upper Heel Footing	100			F4 47	10.5	05			4 007 005		44 75	170 007 051		
	on Lower Heel Footing	130	per	-	51.17	10.0	35			4,307,235		41.75	179,827,051		
,	(vertical volume, no cone action)	130	pcf		23.83	18	42.5			2,369,894		42	99,535,527		
	(vertical volume, no cone action)	130	pcf	1	30	10	29.25			1 140 750		15	17 111 250		
	on Lower Counterfort Footing		201				20.20			1,140,700		.0	17,111,200		
	(vertical volume, no cone action)	130	pcf	1	30	9.5	36.75			1,361,588		15	20,423,813		
LATERAL										13,595,935		30.46	414,125,796		
						[
Saturated soil forces	on Upper end wall area.														Assumes moment-arm
	includes effects from 260 psf surface surcharge	105	psf		51.17		38				3,879,198	12 65		49.087.368	of UPPER foundation
	on Upper end wall counterfort area only.														
	Pressure of 105 psf is per CTWALL results,														Assumes moment-arm
(see COUNTERFORT	Unit force shown is at centroid of counterfort area.	3311	nsf			10	11				364,210	6 47		2,356,439	of UPPER foundation
	on Lower end wall area.														Assumes moment-arm
	includes effects from 260 psf surface surcharge	105	psf		23.83		45.5				2,590,038	15 15		39 242 961	of LOWER foundation
	on Lower end wall counterfort area only.										_,			,	
	Pressure of 105 psf is per CTWALL results,														Assumes moment-arm
spreadsheet)	Unit force shown is at centroid of counterfort area.	3753	psf			9.5	16				570.456	9.76		5.567.651	of LOWER foundation
											7,403,902	13.00		96,254,418	
UPLIFT															
	at Upper channel at inlet/bar screen (UPPER TOE): High Groundwater/Saturated soil up to Elev. 513.0														
Uplift	bottom of base at $510.0 = 3.0$ ft head (uniform load)	62.4	pcf		49.5	51	3			-472,586		25.5		12,050,953	
	at Upper channel at end wall (UPPER HEEL):														
	High Groundwater/Saturated soil up to Elev. 548.0,	60 4	nof		10 E	E1	95			.0 766 754		34.00		02 704 774	
	at I ower channel at inlet/har screen /I OWED TOEV	62.4	per		49.5	51	35			-2,756,754		34.02		93,784,771	
	High Groundwater/Saturated soil up to Elev. 505.5,														
	bottom of base at 502.5 = 3.0 ft head (uniform load)	62.4	pcf		25.33	51	3			-241,831		25.5		6,166,680	
	at Lower channel at end wall (LOWER HEEL): High Groundwater/Saturated soil up to Elev. 548.0	anna de la companya d									To the second seco				
	bottom of base at 505.5 = 42.5 ft head (triangular load)	62.4	pcf		25.33	51	42.5			-1,712.967		34.02	CULT AND AND A LONG	58,275,123	
	· · · · · ·									-5,184,138		32.85		170,277,527	
P 10 10 10 10 10 10 10 10 10 10 10 10 10										0 414 707	7 400 000		414 105 700	000 501 0 15	
								1	1	0,411,797	7,403,902		414,125,796	200,031,945	, I

PS Stability.xls Load Case 4

Section 5 Bearing Pressure



Storm Water Pump Station

Bearing Pressure

(File: PS Bearing Pressure.xls)

PROJECT:	TRWD - STO	RM WATER P	UMP STATION						
PROJECT NO:	2521-42275-F	PRSTR.PS							
DESIGNED BY:	E. BJORKLUI	DN			DATE:	1/18/2005			
CHECKED BY:					DATE:				
			Values from S	STABILITY spreads	heet				
	Fdn Length	Fdn Width	Weight	Lateral force	Mom. Resist	Mom. Overturn			
	ft	ft	lbs	lbs	lb-ft	lb-ft			
Case 1	51	75	4,416,469	0	97,228,155	0			
Case 2	51	75	8,203,187	7,403,902	410,561,703	266,531,945			
Case 3	51	75	12,996,118	4,935,898	366,920,543	64,169,375			
Case 4	51	75	8,411,797	7,403,902	414,125,796	266,531,945			
friction coefficient =	0.4								
						Case 1	Case 2	Case 3	Case 4
sliding ratio =	(weight x fric	tion coeff) / lat	eral force =			n/a	0.44	1.05	0.45
overturning ratio =	moment resi	st / moment ov	erturn =			n/a	1.54	5.72	1.55
eccentricity (from CL) (ft) =	1/2 Fdn leng	th - (moment re	esist - moment o	verturn) / weight =		3.49	7.94	2.20	7.95
bearing pressure (psf) =	((weight / Fc	In length) x (1	+\- (6 x (eccen /	Fdn length))) / Fc	n width =				
max bearing pressure (psf) =	((weight / Fc	In length) x (1	+ (6 x (eccen / F	dn length))) / Fdn	width =	1628	4149	4279	4257
min bearing pressure (psf) =	((weight / Fc	In length) x (1	- (6 x (eccen / Fo	dn length))) / Fdn	width =	681	141	2516	141

Section 6 Cell Formulas for Excel Spreadsheets



CELL FORMULAS FOR EXCEL SPREADSHEETS

(Exception is the Center of Gravity (CG) spreadsheets, which were produced using a freeware spreadsheet with the sheet protected by the author)

PROJECT:		TRWD - STORM WATER PUMP STATION					
PROJECT NO:		2521-42275-PHSTR.PS					
DESIGNED BY:		E. BJORKLUND			DATE:	1/17/2005	
CHECKED BY:							
UPPER COUNTERFORT							
E.F.P.=	70	psf / ft of depth					
Depth =	38	It from grade to upper counterfort base					
Centroid =	6.47	ft from centroid to upper counterfort base - SEE CG SPREADSHEET					
Sartion	ground to centraid	pressure at controid	Section	Total Force	Centroid	Moment Arm about unner slah	Moment
Trapezoid	=89-810	=B13*B8	110	=C13*D13	=B10	=F13	=E13*G13
LOWER COUNTERFOR							
E.F.P.=	70	psf / ft of depth				And An Annual Control of Control	an and a start of the
Depth =	45.5	It from grade to base		AND ADDRESS PROVIDED AND ADDRESS ADD	NAMES TANK AND ADDRESS OF	an ba basa na ana ana ana ana ana ana ana ana a	
Centroid =	9.76	It from centrold to base - SEE CG SPHEAUSHEE I					
Section	ground to centroid	pressure at centroid	Section Area	Total Force on Area	Centroid Location	Moment Arm about lower slab	Moment
Tranezoid	=B18-B19	=822*817	152	=C22*D22	=B19	=F22	=F22*G22
	A CONTRACTOR OF A CONTRACTOR O						
UPPER COUNTERFORT							
E.F.P.=	105	psf / ft of depth					
Depth =	38	It from grade to upper counterfort base					
Centroid =	6.47	ft from centroid to upper counterfort base - SEE CG SPREADSHEET					
Section	ground to centroid	pressure at centroid	Section Area	Total Force on Area	Centroid Location	Moment Arm about upper slab	Moment
Trapezoid	=B30-B31	=B34*B29	110	=C34*D34	=B31	=F34	=E34*G34
LOWEN COUNTERFOR							
E.F.P.=	105	psf / ft of depth					
Depth =	45.5	ft from grade to base					
Centroid =	9.76	ft from centroid to base - SEE CG SPREADSHEET					
Section	ground to centroid	pressure at centroid	Section	Total Force on Area	Centroid Location	Moment Arm about lower slab	Moment
Trapezoid	<u>=</u> B39-B40	=B43*B38	152	=C43*D43	=B40	=F43	=E43*G43
	_						

Counterfort-cell formulas.xls COUNTERFORT Storm Water Pump Station Stability Excel Spreadsheet with Cell Formulas Displayed

PROJECT:	TRWD - STORM WATER PUMP STATION												
PROJECT NO:	2521-42275-PRSTR.PS												
DESIGNED BY:	E. BJORKLUND	DATE:	1/18/2005										
CHECKED BY:		DATE:											
STABILITY									1				
Load Condition 1 - I	During Construction												
(dead loads + equip	ment loads, no live loads				Total or Avg	Total or Avg	Total or Avg				Moment Arm	Resisting	Overturning
no soil, no water)		Un	it force	Quantity	Length	Width	Height	Removed	portions	Weight	to Toe	Moment	Moment
				-	(ft)	(ft)	(ft)			(lbs)	(ft)	(Ibs-ft)	(lbs-ft)
VERTICAL									1				
	It wt conc on metal deck/bar joists at 6' spacing/												
Roof D.L.	lighting/etc. minus roof openings	50	psf		23	53		4 x 36sf =	144	=C11*((F11*G11)-J11)	20	=K11*L11	
Building Walls	12" CMU at 20' height minus vent openings	80	psf		53		20	16 x 16 sf =	256	=C12*((F12*H12)-J12)	9.25	=K12*L12	
	12" CMU at 16.5' avg height minus vent openings	80	psf	2	20		16.5	5 x 16 sf =	80	=C13*E13*((F13*H13)-J13)	19.1	=K13*L13	
	12" CMU at 11.5' height minus vent openings	80	psf		53		11.5	8 x 16 sf =	128	=C14*((F14*H14)-J14)	30.75	=K14*L14	
Top Floor Slab	18" thick	225	psf		21.5	50				=C15*F15*G15	19.25	=K15*L15	
Top Floor Beams	2 beams at 2.5' x 1.5' each (beneath slab)	563	pLF	2	50					=C16*E16*F16	16	=K16*L16	
	Upper exterior end wall - 24" avg thickness								1				
C.I.P. Walls	El 548.0 to 513.0 =35' height	300	psf		39.25		35			=C17*F17*H17	31.17	=K17*L17	
	Upper exterior side wall - 24" avg thickness												
	EI (546.5-538.0) to 513.0 =29.25' avg height	300	psf		30		29.25		$\langle \cdot \rangle$	=C18*F18*H18	15.63	=K18*L18	
	Lower (deep) exterior end wall - 27" avg thickness												
	EI 548.0 to 505.5 =42.5' height	338	psf		15.08		42.5			=C19*F19*H19	31.17	=K19*L19	
	Lower (deep) exterior side wall - 27" avg thickness												
	EI (546.5-538.0) to 505.5 =36.75' avg height	338	psf		30		36.75			=C20*F20*H20	15.58	=K20*L20	
	channel divider wall 18" thick												
	El 538.0 to 513.0 =25' height	225	psf	3	30		25			=C21*E21*F21*H21	15	=K21*L21	
	Lower channel divider (side) wall 18" thick	225	psf		30		7.5			=C22*F22*H22	15	=K22*L22	
	Upper counterfort (SOUTH) 24" thick	300	psf	1	5		16			=C23*F23*H23	1	=K23*L23	
	Upper counterfort (MID) 24" thick	300	psf	1	5		16			=C24*F24*H24	16	=K24*L24	
	Upper counterfort (NORTH) 24" thick	300	psf	1	5		16			=C25*F25*H25	31	=K25*L25	
	Lower counterfort (SOUTH) 24" thick	300	psf	1	4.75		23			=C26*F26*H26	1	=K26*L26	
	Lower counterfort (MID) 24" thick	300	psf	1	4.75		23			=C27*F27*H27	16	=K27*L27	
	Lower counterfort (NORTH) 24" thick	300	psf	1	4.75		23			=C28*F28*H28	31	=K28*L28	
Base Slab	36" thick	450	psf		75	51				=C29*F29*G29	25.5	=K29*L29	
Pumps	Upper vertical pumps	30500	lbs	3						=C30*E30	25.5	=K30*L30	
	Lower vertical pump	34500	lbs	1						=C31*E31	25.5	=K31*L31	
	at Upper channels w/ 11.33' width each												
Trash Racks	using 55 ~ 5/8"x6" steel bars x 25' long @ 2.5"c/c	319	lbs	165						=C32*E32	4.25	=K32*L32	
	at Lower channel w/ 11.33' width												
	using 55 ~ 5/8"x8" steel bars x 32' long @ 2.5"c/c	545	lbs	55						=C33*E33	4.25	=K33*L33	
										=SUM(K11:K33)	=M34/K34	=SUM(M11:M33)	

PROJECT:	TRWD - STORM WATER PUMP STATION				ļ					······································					
PROJECT NO:	2521-42275-PRSTR.PS		1/18/2005												
CHECKED BY:		DATE:	1/10/2000	· · · · · · · · · · · · · · · · · · ·											
STABILITY	uring Construction/Maintenance		_												
(dead loads, no equi	pment. no live loads	-	_i		Total or Avg	Total or Avg	Total or Avg		I		Lateral	Moment Arm	Resisting	Overturning	
saturated backfill + lo	ow water/empty + uplift)	Ur	nit force	Quantity	Length	Width	Height	Removed p	ortions	Weight/force	Force	to Toe	Moment	Moment	
VEDTICAL					(ft)	(ft)	(ft)			(lbs)	(lbs)	(ft)	(lbs-ft)	(lbs-ft)	
	It wt conc on metal deck/bar joists at 6' spacing/														
Roof D.L.	lighting/etc. minus roof openings	50	psf		23	53		4 x 36sf =	144	=C11*((F11*G11)-J11)		20	=K11*M11		
Building Walls	12" CMU at 20' height minus vent openings	80	psf		53		20	16 x 16 sf =	256	=C12*((F12*H12)-J12)		9.25	=K12*M12		
	12" CMU at 16.5' avg height minus vent openings	80	psf	2	20		16.5	$5 \times 16 \text{ sf} =$	80	=C13*E13*((F13*H13)-J13)		19.1	=K13*M13		
Top Floor Slab	18" thick	225	psi		21.5	50	11.5	6 X 10 SI =	120	=C14 ((F14 H14)-514) =C15*F15*G15		19.25	=K15*M15		
Top Floor Beams	2 beams at 2.5' x 1.5' each (beneath slab)	563	pLF	2	50					=C16*E16*F16		16	=K16*M16		
	Upper exterior end wall - 24" avg thickness	000			00.05		0.5			01751751147		04.47			
C.I.P. Walls	LI 548.0 to 513.0 =35' height	300	pst		39.25	-	35			=C17*F17*H17		31.17	=K17*M17		
	El (546.5-538.0) to 513.0 =29.25' avg height	300	psf		30		29.25			=C18*F18*H18		15.63	=K18*M18		
	Lower (deep) exterior end wall - 27" avg thickness														
	El 548.0 to 505.5 =42.5' height	338	pst	-	15.08		42.5			=C19*F19*H19		31.17	=K19*M19		
	El (546.5-538.0) to 505.5 =36.75' avg height	338	psf		30		36.75			=C20*F20*H20		15.58	=K20*M20		
	channel divider wall 18" thick														
	El 538.0 to 513.0 =25' height	225	psf	3	30		25			=C21*E21*F21*H21		15	=K21*M21		
	Lower channel divider (side) wall 18" thick	225	pst	4	30 5		7.5			=C22*F22*H22	-	15	=K22*M22		
	Upper counterfort (MID) 24" thick	300	psf	1	5		16			=C24*F24*H24		16	=K23 M23 =K24*M24		
	Upper counterfort (NORTH) 24" thick	300	psf	1	5		16			=C25*F25*H25		31	=K25*M25		
	Lower counterfort (SOUTH) 24" thick	300	psf	1	4.75		23			=C26*F26*H26		1	=K26*M26		
	Lower counterfort (MID) 24" thick	300	pst	1	4.75		23			=C27*F27*H27 -C28*F28*H28		16	=K27*M27 =K28*M28		
Base Slab	36" thick	450	psf	1	75	51	20			=C29*F29*G29		25.5	=K29*M29		
	on Upper Heel Footing														
Soil weight	(vertical volume, no cone action)	130	pcf		51.17	18.5	35			=C30*F30*G30*H30		41.75	=K30*M30		
	(vertical volume, no cone action)	130	ncf		23.83	18	42.5			=C31*E31*G31*H31		42	=K31*M31		
	on Upper Counterfort Footing	1.00	p01		20.00		12.0								
	(vertical volume, no cone action)	130	pcf	1	30	10	29.25		-	=C32*E32*F32*G32*H32		15	=K32*M32		
	on Lower Counterion Footing	130	nof	4	30	9.5	36.75			-000*E00*E00*000*U00		15	-1/22*1/22		
		130	- Ibei	1	30	9.0	30.75			=033 E33 F33 033 F33		=N34/K34	=R33 M33 =SUM(N11:N33)		
LATERAL															
Saturated soil forces	on Upper end wall area.							And							Assumes moment-arm
	includes effects from 260 psf surface surcharge	105	ncf		51 17		38				=C36*H36^2/2*E36	=H36*0 333		=I 36*M36	of UPPER foundation
	on Upper end wall counterfort area only.	1.00			01117	-	00					-1100 0.000			
	Pressure of 105 psf is per CTWALL results,														Assumes moment-arm
(see COUNTERFORT	includes effects from 260 psf surface surcharge.														rotation about bottom
spreadsheet)	Unit force shown is at centroid of counterfort area.	3311	pcf			10	11				=C37*G37*H37	6.47		=L37*M37	of UPPER foundation
	on Lower end wall area														Assumes moment-arm
	Pressure of 105 psf is per CTWALL results,														rotation about bottom
	includes effects from 260 psf surface surcharge	105	pcf		23.83		45.5				=C38*H38^2/2*F38	=H38*0.333		=L38*M38	of LOWER foundation
	on Lower end wall counterfort area only.							uk (), ii , jaar							
	Pressure of 105 pst is per CTWALL results,														Assumes moment-arm
spreadsheet)	Unit force shown is at centroid of counterfort area.	3753	pcf			9.5	16				=C39*G39*H39	9.76		=L39*M39	of LOWER foundation
											=SUM(L36:L39)	=O40/L40		=SUM(O36:O39)	
UPLIFT															
	at Upper channel at inlet/bar screen (UPPER TOE):														
Unlift	bottom of base at $510.0 = 3.0$ ft head (uniform load)	62.4	ncf		49 5	51	3					25.5		=-K42*M42	
- F	at Upper channel at end wall (UPPER HEEL):						0					20.0			
	High Groundwater/Saturated soil up to Elev. 548.0,														
	bottom of base at 513.0 = 35.0 ft head (triangular load)	62.4	pcf		49.5	51	35			=-0.5*(C43*F43*G43*H43)		34.02		=-K43*M43	
-	at Lower channel at inlet/bar screen (LOWER TOE):														
	High Groundwater/Saturated soil up to Elev. 505.5 ,	62.4	ncf		25.33	51	q					25.5			
	at Lower channel at end wall (LOWER HEEL):	02.4	-pei	-	20.00	JI	5			044 644 644		20.0		<u>1\44 IVI44</u>	
	High Groundwater/Saturated soil up to Elev. 548.0,										The second s				
	bottom of base at 505.5 = 42.5 ft head (triangular load)	62.4	pcf		25.33	51	42.5			=-0.5*(C45*F45*G45*H45)		34.02		=-K45*M45	
										······································					
										=SUM(K42:K45)		=046/-K46		=SUM(042:045)	
· · · · · · · · · · · · · · · · · · ·										=SUM(K42:K45)	-1.40	=046/-К46	-N34	=SUM(O42:O45)	

PS Stability-cell formulas.xls Load Case 2

PROJECT:	TRWD - STORM WATER PUMP STATION													
PROJECT NO:	2521-42275-PRSTR.PS													
DESIGNED BY:	E. BJORKLUND	DATE:	1/18/2005											
CHECKED BY:		DATE:						1						
	· · · · · · · · · · · · · · · · · · ·													
STABILITY	·													
Load Condition 3 - No	ormal													
(dead loads + equipm	nent + live loads,				Total or Avg	Total or Avg	Total or Avg				Lateral	Moment Arm	Resisting	
unsaturated backfill +	Iow water/empty, no uplift)	Un	it force	Quantity	Length	Width	Height	Removed	portions	Weight/force	Force	to Toe	Moment	
					(ft)	(ft)	(ft)		1	(lbs)	(lbs)	(ft)	(lbs-ft)	-
VERTICAL										(
Roof L.L.		55	psf		23	53		1		=C11*F11*G11		20		
	It wt conc on metal deck/bar joists at 6' spacing/		1	1										-
Roof D.L.	lighting/etc. minus roof openings	50	psf		23	53		4 x 36sf =	144	=C12*((F12*G12)-,112)		20	=K12*M12	
Building Walls	12" CMI at 20' height minus vent openings	80	nsf	1	53		20	16 x 16 sf -	256	-C13*/(F13*H13)-113)		9.25	-K13*M13	+
	12" CMU at 16.5' avg height minus vent openings	80	nsf	2	20	-	16.5	5 x 16 ef -	80	-C14*E14*((E14*H14)-114)	· · · · · · · · · · · · · · · · · · ·	10.1	-K14*M14	+
	12" CMU at 11.5' beight minus vent openings	80	nef	f~	53		11.5	8 x 16 cf -	100	-C15*((E15*U15), 115)		20.75	_K15*M15	
Top Floor Slab L L	12 ONO de 11.0 hoight minds voire openings	200	nef		20	50	11.5	0 x 10 31 -	120	-C16*E16*C16				
Top Floor Slab	18" thick	200	por		215	50				-C17*E17*G17		10.25	_K17*M17	
Top Floor Beams	2 hears at 2 5' x 1 5' each (heneath slah)	563	poi E	0	50	150						19.20		
TOP FILLOI Deams	Lippor ovtorior and well 24th ave thickness	565	pr-	2	50					=018 E18 F18		10	=K18"M18	\rightarrow
	Clock of the stand of the stand	000			00.05					0.000 000 000 000 000 000 000 000 000 0				
C.I.P. Walls	EI 548.0 to 513.0 =35 neight	300	psr		39.25		35			=C19*F19*H19		31.17	=K19*M19	
	Upper exterior side wall - 24" avg thickness													
	EI (546.5-538.0) to 513.0 =29.25' avg neight	300	pst		30		29.25			=C20*F20*H20		15.63	=K20*M20	
	Lower (deep) exterior end wall - 27" avg thickness													1
	EI 548.0 to 505.5 =42.5' height	338	psf		15.08		42.5			=C21*F21*H21		31.17	=K21*M21	
	Lower (deep) exterior side wall - 27" avg thickness		1.1.1											
	El (546.5-538.0) to 505.5 =36.75' avg height	338	psf		30		36.75			=C22*F22*H22		15.58	=K22*M22	
	channel divider wall 18" thick													
	El 538.0 to 513.0 =25' height	225	psf	3	30		25			=C23*E23*F23*H23		15	=K23*M23	
	Lower channel divider (side) wall 18" thick	225	psf		30		7.5			=C24*F24*H24		15	=K24*M24	
	Upper counterfort (SOUTH) 24" thick	300	psf	1	5		16			=C25*F25*H25	-	1	=K25*M25	
	Upper counterfort (MID) 24" thick	300	psf	1	5		16			=C26*F26*H26		16	=K26*M26	
	Upper counterfort (NORTH) 24" thick	300	psf	1	5	1	16			=C27*F27*H27		31	=K27*M27	
	Lower counterfort (SOUTH) 24" thick	300	psf	1	4.75	1	23			=C28*F28*H28	-	1	=K28*M28	
	Lower counterfort (MID) 24" thick	300	losf	1	4.75		23			=C29*F29*H29		16	=K29*M29	
	Lower counterfort (NORTH) 24" thick	300	psf	1	4 75		23			=C30*E30*H30		31	-K30*M30	
Base Slab	36" thick	450	nsf	-	75	51				-C31*E31*G31		25.5	-K31*M31	
Pumps	Upper vertical numps	30500	lhs	3		01				-C32*E32		25.5	-1(01 101	+
1 dilipo	l ower vertical nump	34500	lbe	1						=032 E32		25.5	-K02 W02	_
	at Lippor chappels w/ 11 22' width each	04000	103				-			=033 £33		20.0	=100 1000	
Trach Backs	using EE E/8"v6" stool hore v 25' long @ 2.5"e/e	010	lha	105						004504		4.05	1/0/11/0/	
HIdSH HIDGKS	Using 55 ~ 5/8 x6 steel bars x 25 long @ 2.5 c/c	319	lbs	165						=034*E34		4.25	=K34^M34	
	at Lower channel W/ 11.33' width													
	using 55 ~ 5/8"x8" steel bars x 32' long @ 2.5"c/c	545	lbs	55					ļ	=C35*E35		4.25	=K35*M35	
o	on Upper Heel Footing													
Soil weight	(vertical volume, no cone action)	100	pcf		51.17	18.5	35			=C36*F36*G36*H36		41.75	=K36*M36	
	on Lower Heel Footing													
	(vertical volume, no cone action)	100	pcf		23.83	18	42.5			=C37*F37*G37*H37		42	=K37*M37	
	on Upper Counterfort Footing													
	(vertical volume, no cone action)	100	pcf	1	30	10	29.25			=C38*E38*F38*G38*H38		15	=K38*M38	
	on Lower Counterfort Footing													
	(vertical volume, no cone action)	100	pcf	1	30	9.5	36.75			=C39*E39*F39*G39*H39		15	=K39*M39	
	Upper channels w/ Max Design Flow WS Elev.							CONTRACT CONTRACTOR						
Water weight	Elev. 527.3 to 513.0 base = 14.3' water height	62.4	pcf	3	30	11.33	14.3			=C40*E40*F40*G40*H40		15	=K40*M40	
	Lower channels w/ Max Design Flow WS Elev.		1											
	Elev. 527.3 to 505.5 base = 21.8' water height	62.4	pcf	1	30	11.33	21.8			=C41*E41*F41*G41*H41		15	=K41*M41	
							1			=SUM(K13'K41)	1	=N42/K42	=SUM(N11:N41)	1
LATERAL														
	a		-		İ									+
I Insaturated call foreca	on Linner and well area													
Unsaturated soli forces	Dropper end wall area.													
	Pressure of 70 psr is per C1 WALL results,	70			F4 47							111110 000		Ι.
	Includes effects from 260 psr surface surcharge	70	pcr		51.17		38				=C44*H44^2/2*F44	=H44*0.333		
	on Upper end wall counterfort area only.													
	Pressure of 70 psf is per CTWALL results,													
(see COUNTERFORT	includes effects from 260 psf surface surcharge.												A STATE	
spreadsheet)	Unit force shown is at centroid of counterfort area.	2207	pcf			10	11				=C45*G45*H45	6.47		=l
	on Lower end wall area.													
	Pressure of 70 psf is per CTWALL results													
	includes effects from 260 nsf surface surcharge	70	ncf		23.83		45.5				-016*44602/2*546	-446*0 222		
	on Lower and wall counterfort area only	1.0	101		20.00						-040 1140 2/2 F40		-	
	Procesure of 70 per is per CTMALL require								-					
	Includes officiate from 260 pet outface surplaces													
(See COUNTERFUR)	Includes enects norm 200 psi surface surcharge.	0500												
spreausneet)	ornit force shown is at centroid of counterfort area.	2502	pct			9.5	16				C47*G47*H47	9.76		<u> = </u>
											=SUM(L44:L47)	=048/L48		=
							i					-		
				-			I T			=K42	=L48	1	=N42	=(

Overturning	
Moment	
(lbo ft)	
(105-11)	
	Assumes moment-arm
	Assumes moment-arm rotation about bottom
=L44*M44	Assumes moment-arm rotation about bottom of UPPER foundation
=L44*M44	Assumes moment-arm rotation about bottom of UPPER foundation
=L44*M44	Assumes moment-arm rotation about bottom of UPPER foundation
=L44*M44	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm
=L44*M44	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom
=L44*M44 =L45*M45	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation
=L44*M44 =L45*M45	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation
=L44*M44 =L45*M45	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation
=L44*M44 =L45*M45	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom
=L44*M44 =L45*M45	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation
=L44*M44 =L45*M45 =L46*M46	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation
=L44*M44 =L45*M45 =L46*M46	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation
=L44*M44 =L45*M45 =L46*M46	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation Assumes moment-arm
=L44*M44 =L45*M45 =L46*M46	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation Assumes moment-arm rotation about bottom
=L44*M44 =L45*M45 =L46*M46 =L47*M47	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation Assumes moment-arm rotation about bottom of LOWER foundation
=L44*M44 =L45*M45 =L46*M46 =L47*M47 =SUM(O44:O47)	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation Assumes moment-arm rotation about bottom of LOWER foundation
=L44*M44 =L45*M45 =L46*M46 =L46*M46 =L47*M47 =SUM(044:O47)	Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of UPPER foundation Assumes moment-arm rotation about bottom of LOWER foundation Assumes moment-arm rotation about bottom of LOWER foundation

PROJECT:	TRWD - STORM WATER PUMP STATION		1												
DESIGNED BY:	2521-42275-PRSTR.PS E. BJORKLUND	DATE:	1/18/2005												
CHECKED BY:		DATE:													
		_													
Load Condition 4 - No	ormal			_											
(dead loads + equipm	ent loads, no live loads		,		Total or Avg	Total or Avg	Total or Avg				Lateral	Moment Arm	Resisting	Overturning	
saturated backfill + lo	ow water/empty + uplift)	Ur	it force	Quantity	Length	Width (ft)	Height (ft)	Removed	portions	Weight/force	Force	to Toe	Moment (lbs-ft)	Moment (lbs-ff)	
VERTICAL					(19	(11)	(1)		1	(103)	(103)	(1)	(103-11)	(103-17)	
	It wt conc on metal deck/bar joists at 6' spacing/														
Building Walls	12" CMU at 20' height minus vent openings	50 80	pst		23 53	53	20	4 x 36st =	144 256	=C11*((F11*G11)-J11) =C12*((F12*H12)-J12)		20 9 25	=K11*M11 =K12*M12		
•	12" CMU at 16.5' avg height minus vent openings	80	psf	2	20		16.5	5 x 16 sf =	80	=C13*E13*((F13*H13)-J13)		19.1	=K13*M13		
Top Elect Slob	12" CMU at 11.5' height minus vent openings	80	psf		53	50	11.5	8 x 16 sf =	128	=C14*((F14*H14)-J14)		30.75	=K14*M14		
Top Floor Beams	2 beams at 2.5' x 1.5' each (beneath slab)	563	pSr	2	21.5 50	50				=C15*F15*G15 =C16*E16*F16		19.25	=K16*M16		
	Upper exterior end wall - 24" avg thickness	-	1												
C.I.P. Walls	El 548.0 to 513.0 =35' height	300	psf	-	39.25		35			=C17*F17*H17		31.17	=K17*M17	1	
	El (546.5-538.0) to 513.0 =29.25' avg height	300	psf		30		29.25			=C18*F18*H18		15.63	=K18*M18		
	Lower (deep) exterior end wall - 27" avg thickness														
	Lower (deep) exterior side wall - 27" avg thickness	338	pst		15.08		42.5			=C19*F19*H19		31.17	=K19*M19		
	El (546.5-538.0) to 505.5 =36.75' avg height	338	psf		30		36.75			=C20*F20*H20		15.58	=K20*M20		
	channel divider wall 18" thick	005		0	00		05					45	Kotthiot		
	Lower channel divider (side) wall 18" thick	225	pst	3	30		25 7.5			=C21*E21*F21*H21 =C22*F22*H22		15	=K21*M21 =K22*M22		
	Upper counterfort (SOUTH) 24" thick	300	psf	1	5		16			=C23*F23*H23		1	=K23*M23		
	Upper counterfort (MID) 24" thick	300	psf	1	5		16			=C24*F24*H24		16	=K24*M24 =K25*M25		
	Lower counterfort (SOUTH) 24" thick	300	psf	1	4.75		23			=C26*F26*H26		1	=K26*M26		
	Lower counterfort (MID) 24" thick	300	psf	1	4.75		23			=C27*F27*H27		16	=K27*M27		
Base Slab	36" thick	450	psi	1	4.75 75	51	23			=C29*F29*G29		25.5	=K28*M28 =K29*M29		
Pumps	upper vertical pumps	30500	lbs	3						=C30*E30		25.5	=K30*M30		
	lower vertical pump at Upper channels w/ 11.33' width each	34500	lbs	1						=C31*E31		25.5	=K31*M31		
Trash Racks	using 55 ~ 5/8"x6" steel bars x 25' long @ 2.5"c/c	319	lbs	165						=C32*E32		4.25	=K32*M32		
	at Lower channel w/ 11.33' width	545	lbc	55								4.05	-1/22*1/22	9 mm	
	on Upper Heel Footing	040	ius.	55						=033 E33		4.20	=N33 1033		
Soil weight	(vertical volume, no cone action)	130	pcf		51.17	18.5	35	··		=C34*F34*G34*H34		41.75	=K34*M34		
	on Lower Heel Footing (vertical volume, no cone action)	130	ncf		23.83	18	42 5			-C35*E35*G35*H35		42	-K35*M35		
	on Upper Counterfort Footing	100			20.00		42.0					14			
	(vertical volume, no cone action)	130	pcf	1	30	10	29.25			=C36*E36*F36*G36*H36		15	=K36*M36		
	(vertical volume, no cone action)	130	pcf	1	30	9.5	36.75			=C37*E37*F37*G37*H37		15	=K37*M37		
3 4										=SUM(K11:K37)		=N38/K38	=SUM(N11:N37)		
Saturated soil forces	on Upper end wall area.														Assumes moment-arm
	Pressure of 105 psf is per CTWALL results,	105									A (A)				rotation about bottom
	Includes effects from 260 psr surface surcharge	105	pst		51.17		38				=C40*H40^2/2*F40	=H40*0.333		=L40*M40	of UPPER foundation
	Pressure of 105 psf is per CTWALL results,														Assumes moment-arm
(see COUNTERFORT	includes effects from 260 psf surface surcharge.														rotation about bottom
spreadsneet)	Unit force shown is at centroid of counterfort area.	3311	pst			10	11				=C41*G41*H41	6.47		=L41*M41	of UPPER foundation
	on Lower end wall area.														Assumes moment-arm
	Pressure of 105 psf is per CTWALL results,	105													rotation about bottom
	on Lower end wall counterfort area only	105	pst		23.83		45.5				=C42*H42^2/2*F42	=H42*0.333		=L42^M42	of LOWER foundation
	Pressure of 105 psf is per CTWALL results,		1 ° 1 MARY 1												Assumes moment-arm
(see COUNTERFORT	includes effects from 260 psf surface surcharge.	0750										. =0		1.0000.00	rotation about bottom
spieausneet		3753	psi			9.5	16				=C43*G43*H43 =SUM(140*143)	=044/1 44	4	=L43*IM43 =SUM(O40:O43)	OI LOWER IOUIIdation
UPLIFT	· · · · · · · · · · · · · · · · · · ·											-017211			
	at Upper channel at inlet/bar screen (UPPER TOE):														
Unlift	High Groundwater/Saturated soil up to Elev. 513.0, bottom of base at 510.0 = 3.0 ft head (uniform load)	62.4	ncf		495	51	3			C46*E46*G46*H46		25.5		K46*M46	
	at Upper channel at end wall (UPPER HEEL):	1										20.0			
	High Groundwater/Saturated soil up to Elev. 548.0,														
	bottom of base at 513.0 = 35.0 ft head (triangular load)	62.4	pcf		49.5	51	35			=-0.5*(C47*F47*G47*H47)		34.02		=-K47*M47	
	at Lower channel at inlet/bar screen (LOWER TOE): High Groundwater/Saturated soil up to Elev. 505.5														
	bottom of base at 502.5 = 3.0 ft head (uniform load)	62.4	pcf	;	25.33	51	3			=-C48*F48*G48*H48		25.5		=-K48*M48	
	at Lower channel at end wall (LOWER HEEL):														
	bottom of base at 505.5 = 42.5 ft head (triangular load)	62.4	pcf		25.33	51	42.5			=-0.5*(C49*F49*G49*H49)		34.02		=-K49*M49	
										=SUM(K46:K49)		=O50/-K50		=SUM(O46:O49)	
										-K38+K50	-1 44		-N38	-044+050	
L	1							l				l			.4

Storm Water Pump Station Bearing Pressure Analysis Excel Spreadsheet with Cell Formulas Displayed

PRO JECT:	TRWD - STORM WATER RUND STATION	1	1		1		
PROJECT.							
PROJECT NO:	2521-42275-PRSTR.PS						
DESIGNED BY:	E. BJORKLUND				DATE:	1/18/2005	
CHECKED BY:					DATE:		
	Values	from STABILIT	Y spreadshee	et			
	Fdn Length	Fdn Width	Weight	Lateral force	Mom. Resist	Mom. Overturn	
	ft	ft	lbs	lbs	lb-ft	lb-ft	
Case 1	51	75	4416469	0	97228155	0	
Case 2	51	75	8203187	7403902	410561703	266531945	
Case 3	51	75	12996118	4935898	366920543	64169375	
Case 4	51	75	8411797	7403902	414125796	266531945	
friction coefficient =	0.4						
						Case 1	Case 2
sliding ratio =	(weight x friction coeff) / lateral force =					n/a	=(D10*B16)/E10
overturning ratio =	moment resist / moment overturn =					n/a	=F10/G10
eccentricity (from CL) (ft) =	1/2 Fdn length - (moment resist - moment overturn) / weight =		VI. Alberto VI			=(0.5*B9)-((F9-G9)/D9)	=(0.5*B10)-((F10-G10)/D10)
bearing pressure (psf) =	((weight / Fdn length) x (1 +\- (6 x (eccen / Fdn length)))) / Fdn width =						
max bearing pressure (psf) =	((weight / Fdn length) x (1 + (6 x (eccen / Fdn length)))) / Fdn width =					=((D9/B9)*(1+(6*(G20/B9))))/C9	=((D10/B10)*(1+(6*(H20/B10))))/C10
min bearing pressure (psf) =	((weight / Fdn length) x (1 - (6 x (eccen / Fdn length)))) / Fdn width =					=((D9/B9)*(1-(6*(G20/B9))))/C9	=((D10/B10)*(1-(6*(H20/B10))))/C10

	- (1-m ²) (- m ²) - (- m ²)	
	· · · · · · · · · · · · · · · · · · ·	·
	Case 3	Case 4
	=(D11*B16)/E11	=(D12*B16)/E12
	=F11/G11	=F12/G12
	=(0.5*B11)-((F11-G11)/D11)	=(0.5*B12)-((F12-G12)/D12)
0	=((D11/B11)*(1+(6*(I20/B11))))/C11	=((D12/B12)*(1+(6*(J20/B12))))/C12
)	=((D11/B11)*(1-(6*(I20/B11))))/C11	=((D12/B12)*(1-(6*(J20/B12))))/C12

Section 7 Design of H-Piles (Manual Calculations)



Design of Steel H-Piles (Manual Calculations)
 CLIENT
 TRWD-FWCC
 JOB NO. 2521-42275
 COMPUTER BY E. Bjorklund

 PROJECT
 Storm Water P.S.
 DATE CHECKED
 DATE

 DETAIL
 Foundation
 Design
 CHECKED BY
 PAGE NO.

- CASEZ Vertical Summary = 5714 K Horiz. (Lateral) Summary = 7404 K
- CASE 3 Vertical Summary = 12996 K controls Horiz. (Lateral) Summary = 4936 K
- CASE 4 Vertical Summary = 5923 K Horiz. (Lateral) Summary = 7404 K - controls
 - Need to determine number of piles required.



Assume:
$$HPI4 \times 102$$
 piles for analysis
: Max stress = 10 ksi
: Area = 30 in²
: $P_{max} = 300^{K} each$
 $\frac{134^{K}}{V}$
 $\frac{1}{1}2^{V}$
 $\frac{1}{1}2^{V}$

Number of piles = 12.996 vert = 48.5, soy 50 piles 268 k per pile vert. = 48.5, soy 50 piles tk lateral

Piles per Row

$$\frac{75' \text{ foundation width}}{5' \text{ pile spacing}} = 15 \text{ piles}$$

Suggest adding some number of piles symmetrically to provide for balanced distribution

Section 8 Seismic Load Case Check



Stability Analysis Seismic Load Case Check (Manual Calculations)

JAN-19-2005 11:56AM	FROM-Camp Dresser & McKee	+13032989886 T-926	P.002/006 F-558
	VLIENT		
	PROJECT FWCC	DATE CHECKED	DATE 1-19-05
	DETAIL PUMP STATION SEISMIC	CHECKED BY	PAGE ND.

SEISMIC ANALYSIS AT PUMP STATION:

HORIZ. GRUND ACCELERATION = 0.05 9 NEGLECT KY 4 = tan - (KA) = 2-86 Q1 = 24.85 ° REFER TO SEISMIC KAE = 0.442 ANALYSIS AT FreeDuALLS STATIC KA = 0,408 AKAE = KAE - KA = 0,034 - FROM LOAD CONDITION 4 INERTIA OF MASS (CONC, EXVIP, & SCIL) = 0,05(13,595,935) = 679,797. Abs SOIL PRESSURES W/ ES = 1.10: PAE = PA + PWS + APAE NOTE: CONSIDER FOR ONLY FOR PAE = PA + PWS + APAE ARE AND FOR 75' WIDTH ONLY FOR PRELIMINARY STUDY. = = Ka 86 h2 + = Swh2 + = DKAE 8 h2 $=\frac{1}{2}\left(0,408\right)\left(\frac{130-62.5}{1000}\right)\left(38\right)^{2}+\frac{1}{2}\left(0,0625\right)\left(38\right)^{2}+\frac{1}{2}\left(0,034\right)\left(0,130\right)\left(38\right)^{2}$ = 19.9 + 451 + 3,2 = 68.2 K/1 x 75' wiDTH = 5115 K TOTAL LATERAL FORCE = 680. +5115. = 5795." EQUIVALENT STATIC' LATERAL FORCE USED IN LOAD CONDITION 4 = ± (0.105) (38)2 = 75.8 K/1 × 75' = 5686. . ستجر 5795 = 1.02 -> 2? ADDL SETSMIC LOADS OXAY IF ALLOW STREES INCREASE IN PILES NOTE: ABOVE ANALYSIS IS APPROXIMATE - IT ISNORES SOIL FORCES AT ...--- COUNTER FORTS- & AT JEDICK PORTION OF THE PUMP STATION BOT INCLUDES THE FULL INERTIA FARLE. RATH OF SEISMIL TO STATIC FORCE IS GUIDERED TO BE CONSERVATIVE.

CONCLUSION: SETSMIC LOAD CASE IS NOT CRITTCAL.