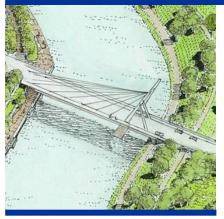


Fort Worth Central City Preliminary Design



Civil/Structural Preliminary Design



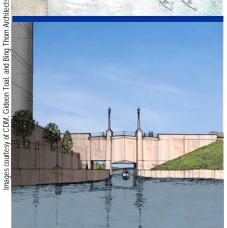
Draft Environmental Impact Statement

Appendix C

May 2005



Volume III – Stability Analysis Isolation Gates









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Section 1 Index of Excel Spread Sheets



STABILITY ANALYSES TRWD ISOLATION GATE STRUCTURE

Index of Excel Spreadsheets:

Mass Concrete Foundation:

I1 SPF-NoDrain-Mass TRWD.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-Mass TRWD.XLS

(Maximum Water Level Case)

I2 MAX-Drain-Mass TRWD.XLS

(Maximum Water Level Case, incl. foundation drains)

Roller Compacted Concrete Foundation:

I1 SPF-NoDrain-RCC TRWD.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-RCC TRWD.XLS

(Maximum Water Level Case, at top of RCC)

I2 MAX-NoDrain-RCC-Base TRWD.XLS

(Maximum Water Level Case, at base of RCC)

Pile Foundation:

I1 SPF-NoDrain-Pile TRWD.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-Pile TRWD.XLS

(Maximum Water Level Case)

I3 SEISMIC-NoDrain-Pile TRWD.XLS

(Normal Pool Level, with Seismic)

STABILITY ANALYSES TRINITY POINT ISOLATION GATE STRUCTURE

Index of Excel Spreadsheets:

Mass Concrete Foundation:

I1 SPF-NoDrain-Mass TPoint.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-Mass TPoint.XLS

(Maximum Water Level Case)

I2 MAX-Drain-Mass TPoint.XLS

(Maximum Water Level Case, incl. foundation drains)

Roller Compacted Concrete Foundation:

I1 SPF-NoDrain-RCC TPoint.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-RCC TPoint.XLS

(Maximum Water Level Case, at top of RCC)

I2 MAX-NoDrain-RCC-Base TPoint.XLS

(Maximum Water Level Case, at base of RCC)

Pile Foundation:

I1 SPF-NoDrain-Pile TPoint.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-Pile TPoint.XLS

(Maximum Water Level Case)

I3 SEISMIC-NoDrain-Pile TPoint.XLS

(Normal Pool Level, with Seismic)

STABILITY ANALYSES CLEAR FORK ISOLATION GATE STRUCTURE

Index of Excel Spreadsheets:

Mass Concrete Foundation:

I1 SPF-NoDrain-Mass CFork.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-Mass CFork.XLS

(Maximum Water Level Case)

I2 MAX-Drain-Mass CFork.XLS

(Maximum Water Level Case, incl. foundation drains)

Roller Compacted Concrete Foundation:

I1 SPF-NoDrain-RCC CFork.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-RCC CFork.XLS

(Maximum Water Level Case, at top of RCC)

I2 MAX-NoDrain-RCC-Base CFork.XLS

(Maximum Water Level Case, at base of RCC)

Pile Foundation:

I1 SPF-NoDrain-Pile CFork.XLS

(Standard Project Flood Case)

I2 MAX-NoDrain-Pile CFork.XLS

(Maximum Water Level Case)

I3 SEISMIC-NoDrain-Pile CFork.XLS

(Normal Pool Level, with Seismic)

Section 2 TRWD Isolation Gate StructuresMass Concrete Foundation



TRWD Isolation Gate Structure Usual Load Condition - SPF

(File I1 SPF-NoDrain-Mass TRWD.XLS)

- 1. Mass concrete foundation on rock.
- 2. Sliding Factor of Safety = 1.50
- 3. SPF level at El 540.0 on driving side.
- 4. Tailwater at El 520.0 on resisting side.
- 5. Friction angle at rock = 35 degrees.

PROJECT: TRWD . FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: TOO

DATE: 12/18/2004 DATE: 12/20/04

GATE STRUCTURE STABILITY (W/ UPLIFT) SPF WATER ELEVATION (USUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

	1.5	35 DEGREES		62.5 PCF	150 PCF							25.02 DEGREES	O PSF	4125 PSF	2875 PSF			22 FT	E-BE-TTHI)	47 1.1	WH + TW)	58 FT	+ PN*PT)	
	FACTOR OF SAFETY (FS):	ACTUAL SOIL FRICTION ANGLE (PHI):	ACTUAL SOIL COHESION (CN):	FLUID PRESS (EFP):	CONC UNIT WGT (CUM):					RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID):	DESIGN COHESION (CND):	UPLIFT AT HEEL (UH):	UPLIFT AT TOE (UT):			CONCRETE WEDGE HEIGHT & LGTH (WH) :	(MH = CSE-BE-TTII)	FDN LENGTH (L):	(L = HW + PL + WH + TW)	FDN WIDTH (B):	(B = CGW + WGW + PN*PT)	
	E.	TH	FT	£	EA	FT		FT	Ŀ'I'			FT	LL	LBS			LA	1	LBS		FT	FT	1	ĿŢ
	540	520	557	474	25	7.33	'n	86	13			24	518	15,000 LBS			12	530	5,000 LBS		0	0	0	22
GATE STRUCTURE:	FLOOD ELEV (FE):	TAILWATER ELEV (TE):	TOP OF PIER ELEV (PE):	FDN BASE EL (BE):	PIER LENGTH (PL):	PIER THICKNESS (PT):	NO. OF CONC PIERS (PN):	UPPER STRUCTURE OUTLINE (USO):	UPSTREAM FACE TO GATE CTR LINE (GCL):		CHANNEL GATE:	GATE WIDTH (CGW):	SILL ELEV (CSE):	GATE WEIGHT (CGWGT):		WALKWAY GATE;	GATE WIDTH (WGW):	SILL ELEV (WSE):	GATE WEIGHT (WGWGT):		ADDL HEEL WIDTH (HW):	HEEL THICKNESS (HTH):	ADDL TOE WIDTH (TW):	TOE THICKNESS (TTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

DATE: 12/18/2004

CHECKED BY: 2014

DATE: 12 10 04

STABILITY ANALYSIS:

CHANNEL GATE: 15,000 LB 34,00 1000 MALKANAY GATE: 5,000 34,00 34,00 10000 MALKANAY GATE: 5,000 34,00 34,00 10000 MALKANAY GATE: 1,059,000 34,00 34,50 111,003,750 10000 MALKANAY BUCK ENN: 1,059,000 34,50 34,50 34,50 34,50 34,50 34,50 MALKANAY BUCK ENN: 1,000,400 34,50 34,50 34,50 34,50 34,50 MALKANAY BUCK ENN: 1,306,200 12,25 16,003,944 MALKANAY BUCK ENN: 1,306,200 47,00 12,25 16,003,944 MALKANAY BUCK ENN: 1,306,200 12,20 12,25 16,003,944 MALKANAY BUCK ENN: 1,306,200 12,20 12,20 16,003,944 MALKANAY BUCK ENN: 1,306,200 12,20 12,20 16,003,944 MALKANAY BUCK ENN: 1,306,200 12,200 12,20 16,003,944 MALKANAY BUCK ENN: 1,306,200 12,200 12,20 1	STABILLTY ANALYSIS:					
15,000 1,058,400 1,058,400 1,058,400 2,520,000 1,306,800 1,306,800 1,306,800 1,306,800 1,306,000 877,250 12,490,350 12,490,350 144 >1.0? 160 >1.0? 174 >1.0? 184 >1.0? 194 >1.0? 106 >1.0? 106 >1.0? 1144 >1.0? 106 >1.0? 107 >1.0? 108 >1.0? 10		WEIGHT	LATL FORCE:	ARM TO TOE:	RESISTING MOMENT:	OVERTURNING MOMENT:
5,000 1,058,400 1,058,400 2,520,000 1,306,800 1,306,800 0 0 0 1,306,800 0 0 1,306,800 0 0 1,306,800 0 1,306,800 1,306,800 1,3835,250 12,490,350 12,490,350 144 >1.0? 144 >1.0? 160 >1.00 174 >1.0? 180 = 1.60 190 >1.00 100 >1.00 114 >1.0? 100 >1.00 100 >1.00	CHANNEL GATE:	15,000	1	34.00	510,000	
3,217,500 1,058,400 5,009,400 2,520,000 1,306,800 0 0 342,000 877,250 -7,837,250 -1,703,750 -3,835,250 12,490,350 4,060,000 144 >1.0? 144 >1.0? 144 >1.0? 144 >1.0? 144 >1.0? 160 >1.0? 170 >1.00 180 >1.00 190 >1.00 190 >1.00 110 >	WALKWAY GATE:	5,000		34.00	170,000	
1,058,400 1,590,000 1,590,000 1,306,800 0 0 1,306,800 1,306,800 877,250 877,250 -7,837,250 -3,835,250 12,490,350 12,490,350 144 >1.0? 144 >1.0? 160 >1.0? 1703,780 180 >1.895,250 11,40 >1.895,250 12,490,350 180 >1.895,250 11,40 >1.895,250 1,830,558 I.B 1,40 >1.0? 1,60 >	CONCRETE PIERS:	3,217,500		34.50	111,003,750	
7,590,000 5,009,400 2,520,000 1,306,800 0 0 1,306,800 1,306,800 1,306,800 1,30,000 1,3835,250 1,490,350 1,835,250 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,4490,350 1,5890,000 1,600,000	UPPER STRUCTURE:	1,058,400		34.50	36,514,800	
5,009,400 2,520,000 1,306,800 0 0 342,000 877,250 -7,837,250 -3,835,250 12,490,350 4,060,000 12,490,350 144 >1.0? 160 >1.0? 3,80 (RELATIVE TO CL 3,80 (RELATIVE TO CL	CHANNEL BLOCK FDN:	7,590,000		34.50	261,855,000	
2,520,000 1,306,800 0 0 342,000 877,250 -7,837,250 -3,835,250 12,490,350 4,060,000 12,490,350 4,060,000 12,490,000 LB -1,703,750 7,895,250 -3,835,250 12,490,350 1.8 = 10.00 12,490,000 LB -1,600,000 LB -1,600,000 LB -1,600,000 LB -2,830,558 LB -3,830,558 LB -3,830,588 LB	CHANNEL WEDGE FDN:	5,009,400		12,25	61,348,452	
1,306,800 1,342,000 1,342,000 1,342,000 1,342,000 1,343,250 1,3437,250 1,3835,250 1,3490,350 1,3835,250 1,440,350 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,440,10? 1,5830,5581,8 1,600,108 1,6	WALKWAY BLOCK FDN:	2,520,000		34.50	86,940,000	
342,000 90,000 877,250 -7,837,250 -3,835,250 -3,835,250 -3,835,250 12,490,350 4,060,000 144 >1.0? = 4,060,000 LB 1.60 >1.0? = 1.44 >1.0? = 1.60 >1.0? = 1.60 >1.0? = 2358 PSF 5,112 CY	WALKWAY WEDGE FON:	1,306,800		12.25	16,003,944	
342,000 90,000 877,250 -7,837,250 -1,703,750 -3,835,250 -3,835,250 -3,835,250 12,490,350 4,060,000 1.44 >1.0? -1.60 >1.0? -1.60 >1.0? -2358 PSF -1.11 CY	HEEL SLAB:	0		47.00	0	
342,000 90,000 877,250 -7,837,250 -3,835,250 12,490,350 4,060,000 1.44 >1.0? -1.703,750 -3,835,250 -3,83	TOE SLAB:	0		00.00	0	
342,000 877,250 17,837,250 12,490,350 12,490,350 12,490,350 12,490,350 14,060,000 1.44 >1.0? 1.44 >1.0? 1.44 >1.0? 1.44 >1.0? 1.44 >1.0? 1.44 >1.0? 1.46 >1.0? 1.60 >1.0? 1.60 >1.0? 2358 PSF 2358 PSF 5,112 CY	FLUID ON HEEL:	0		4.7.00	C	
90,000 12,837,250 12,490,350 12,490,350 12,490,350 12,490,000 13,835,250 13,490,350 14,060,000 144 >1.0? 144 >1.0? 160 >1	FLUID ON CHANNEL SILL:	342,000		41.00	14,022,000	
### ##################################	FLUID ON WALKWAY SILL:	90,000		41.00	3,690,000	
: -7,837,250 : -1,703,750 -3,835,250 : 12,490,350 4,060,000 : 5,830,558 LB = 0 LB = 1.44 >1.0? = 4,060,000 LB = 1.44 >1.0? = 1.60 >1.0? = 1.580 (RELATIVE TO CL 2.3.80 (RELATIVE TO CL 2.3.80 (RELATIVE TO CL 2.3.80 PSF S.3.80 (RELATIVE TO CL 2.3.80 PSF S.3.80 (RELATIVE TO CL 2.3.80 PSF S.3.80 (RELATIVE TO CL 3.3.80	FLUID ON D/S WEDGE:	877,250		7.33	6,433,167	
: -7,837,250 : -1,703,750 -3,835,250 : 12,490,350 4,060,000 : 5,830,5581.B = 0.1B -1.44 >1.0? = 1.44 >1.0? = 1.60 >1.0? 3.80 (RELATIVE TO CL 3.80 (RELATIVE TO CL 5,835 PSF = 5,112 CY	FLUID ON TOE:	0		00.00	C	
: -1,703,750	UPLIFT FORCE (U1):	-7,837,250		23.50		184,175,375
7,895,250 -3,835,250 -3,835,250 -3,835,250 -3,830,558 LB = = 0 1.8 0 LB = 1 1.44 > 1.0? = = 1 1.60 > 1.0? = = 1 1.60 > 1.0? = = 1 1.60 > 1.0? = = 1 1.60 > 1.0? = = 2.3.80 (RELATIVE TO CL 2.3.80 PSF = 2.358 PSF = 2.358 PSF = 5.112 CY	UPLIFT FORCE (U2):	-1,703,750		31.33		53,384,167
= 3,835,250 12,490,350 4,060,000 = 5,830,558 LB = 0 0 LB = 1 1.44 >1.0? = 1 1.60 >1.0? = 1 1.60 >1.0? = 1 2380 (RELATIVE TO CL SED	FLUID HORIZ FORCE (H):		7,895,250	22.00		173,695,500
12,490,350 4,060,000 5,830,558 I.B = 0 I.B = 1.4,060,000 I.B = 1.60 > 1.0? = 1.60 > 1.0? = V/I.(1+-6*E/L)	RESISTING FLUID FORCE:		-3,835,250	15.33	58,807,167	
5,830,558 LB = 0 LB = 1.44 >1.09 = 1.60 >1.00 LB = 1.44 >1.0? = 1.60 >1.0? = 2.80 (RELATIVE TO CL	SUBTOTAL AT BASE (V, MR, MO)	12,490,350	4,060,000		657,298,279	411,255,042
5,830,558 LB = 0 LB = 0 LB = 1.44 >1.0? = 1.60 >1.0? = 1.60 >1.0? = 2358 PSF = 2358 PSF = 5,112 CY	STABILITY RESULTS:					
	RICTION FORCE (V*TAN(PHID)) = COHESION FORCE (CND*L*B) = NET SLIDING FORCE = SLIDING RATIO = OVERTURNING RATIO (MR/MO) = NTRICITY (E=L/2-(MR-MO)/V)) BEARING PRESSURE = V MAX BEARING PRESS = MIN BEARING PRESS = MIN BEARING PRESS =	5,830,558 0 4,060,000 1.44 1.60 3.80 7.1,(1+-6*E/L) 6805 2358 5,112	.0? .0? ELATIVE TO F	COMESTIVAL CONCENTRATION + BASE DRIVING FORCES (FRICTION + CCCL)	: + GATES + WATE SE AREA S MINUS ACTIVE R DHESION) / (NET SL	R - UPLIFT) ESISTING FORCES IDING)

TRWD Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-Mass TRWD.XLS)

- 1. Mass concrete foundation on rock.
- 2. Sliding Factor of Safety = 1.33
- 3. Maximum water level at El 544.0 on driving side.
- 4. Tailwater at El 520.0 on resisting side.
- 5. Friction angle at rock = 35 degrees.

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY:

DATE: 12/18/2004 DATE: 12/20/04

DO

CHECKED BY:

MAXIMIM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION) GATE STRUCTURE STABILITY (W/ UPLIFT)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

27.77 DEGREES 0 PSF 4375 PSF 2875 PSF DEGREES IGHT & LGTH (WH): 22 FT (WH = CSE-BE-TTH) FUN LENGTH (L): 47 FT (L = HW + PL + WH + TW) FUN WIDTH (B): 58 FT PSF (B = CGW + WGW + PN*PT) 1.33 35 62.5 150 CONCRETE WEDGE HEIGHT & LIGTH (WH): DESIGN COHESTON (CND): DESIGN FRICTION ANGLE (PHID): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT): FACTURE OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (PHI): FLUID PRESS (EFP) : ACTUAL SOIL COHESION (CN) : CONC UNIT WGT (CUW) : RESULTING DESIGN VALUES & DIMENSIONS: 24 FT 518 FT 15,000 LBS 12 FT 530 FT 5,000 LBS 520 FT 557 FT 774 FT 25 FT 7.33 FT 3 98 FT 13 FT FFF 0002 FLOOD ELEV (FE): TAILWATER ELEV (TE): TOP OF PIER ELEV (PE): FDN BASE EL (BE): PIER LENGTH (PL): PIER THICKNESS (PT): GATE WIDTH (CGW): SILL ELEV (CSE): WALKWAY GATE: GATE WIDTH (WGW): SILL ELEV (WSE): ADDL TOE WIDTH (TW): TOE THICKNESS (TFH): HEEL THICKNESS (HTH): NO. OF CONC PIERS (PN): UPSTREAM FACE TO GATE CIT LINE (GCL): CATE WEIGHT (CGWGT): GATE WEIGHT (WGWGT): ADDL HEEL, WIDTH (HW): CHANNEL GATE: GATE STRUCTURE:

PROJECT: TRWD FLOOD GATH CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 1504

DATE: 12/18/2004 DATE: 12/20/04

STABILITY ANALYSIS:					
	WEIGHT:	LATL FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	LB	LB		MOMENT:	MOMENT:
CHANNEL GATE:	15,000		34.00	510,000	
WALKWAY GATE:	5,000		34.00	170,000	
CONCRETE PIERS:	3,217,500		34.50	111,003,750	
UPPER STRUCTURE:	1,058,400		34.50	36,514,800	
CHANNEL BLOCK FON:	7,590,000		34.50	261,855,000	
CHANNEL WEDGE FON:	5,009,400		12.25	61,348,452	
WALKWAY BLOCK FDN:	2,520,000		34.50	86,940,000	
WALKWAY WEDGE FON:	1,306,800		12,25	16,003,944	
HEEL SLAB:	0		47.00	0	
TOE SLAB:	C		00.0	0	
FLUID ON HEEL:	0		47.00	0	
FLUID ON CHANNEL SILL:	342,000		41.00	14,022,000	
FLUID ON WALKWAY SILE:	90,000		41.00	3,690,000	
FLUID ON D/S WEDGE:	877,250		7.33	6,433,167	
FLUID ON TOE:	0		00.0	0	
UPLIFT FORCE (U1):	7,837,250		23.50		184,175,375
UPLIFT FORCE (U2):	-2,044,500		31,33		64,061,000
FLUID HORIZ FORCE (H):		8,881,250	23,33		207,229,167
RESISTING FLUID FORCE:		-3,835,250	15.33	58,807,167	
SUBTOTAL AT BASE (V, MR, MO) =	12,149,600	5,046,000		657,298,279	455,465,542

STABILITY RESULTS:

FRICTION FORCE (V*TAN(PHID)) = COHESION FORCE (CND*L*B) = NET SLIDING FORCE = SLIDING RATIO OVERTURNING RATIO (MR/MO)	6,396,422 LB 0 LB 5,046,000 LB 1.27 >1.0? 1.44 >1.0?	U*WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION)/(NET SLIDING)
ECCENTRICITY $(E=L/2-(MR-MO)/V)$)=	6.89 (RELATIVE TO CL.)	1.0 CF)
BEARING PRESSURE = V/L(1+-6*E/L)	L(1+-6*E/L)	

8376 PSF 538 PSF 5,112 CY MAX BEARING PRESS =
MIN BEARING PRESS =
VOLUME OF CONCRETE =

TRWD Isolation Gate Structure (with Drains) Unusual Load Condition - Max Water Level

(File I2 MAX-Drain-Mass TRWD.XLS)

- 1. Mass concrete foundation on rock, with foundation drainage system.
- 2. Maximum water level at El 544.0 on driving side.
- 3. Tailwater at El 520.0 on resisting side.
- 4. Drains 33 percent effective, 10-ft downstream of headwall.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

DATE: 12/18/2004 DATE: 12 10 04 CHECKED BY: BDA

GATE STRUCTURE STABILITY (W/ UPLIFT) MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION) DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33	35 DEGREES	O PSF		150 PCF	0.33	13 FT					27.77 DEGREES	O PSF	4375 PSF	2875 PSF	3590 PSF		20 FT	BE-TTH)	45 FT	(ML + H	58 FT	· PN*PT)	
FACTOR OF SAFETY (FS):	ACTUAL SOLL FRICTION ANGLE (PHI):	ACTUAL SOIL CONESION (CN):	FLUID PRESS (EFP):	CONC DNIT WGT (CDM):	DRAIN EFFICIENCY (DE):	DRAIN DIMENSION FROM HEADWALL (DD):			RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID):	DESIGN COHESION (CND):	UPLIFT AT HEEL (UH):	UPLIFT AT TOE (UT):	UPLIFT AT DRAIN (UD):		CONCRETE WEDGE HEIGHT & LGTH (WH):	(WH = CSE-BE-TTH)	FDN LENGTH (1,):	(L - IW + PL + WH + TW)	FDN WIDIH (B):	$(B = CGW + W(3W + PN^*PT)$	
544 FT	520 FT	557 FT		25 FT	7.33 FT	٣	98 FT	13 FT			24 FT	518 FT	15,000 LBS			12 FT	530 FT	5,000 LBS		0 FT	0 FT	0 FT	24 FT
GATE STRUCTURE: FLOOD ELEV (FE):	ELEV	TOP OF PIER ELEV (PE):	FDN BASE EL (BE):	PIER LENGTH (PL):		NO. OF CONC PIERS (PN):	UPPER STRUCTURE OUTLINE (USO):	TREAM FACE TO GATE CTR LINE (GCL):		CHANNEL GATE:	GATE WIDTH (CGW):	SILL ELEV (CSE):	GATE WEIGHT (CGWGT):		WALKWAY GATE:	GATE WIDTH (WGW):	SILL ELEV (WSE):	GATE WEIGHT (WGWGT):		ADDI, HEEL WIDIN (HW):	HEEL THICKNESS (H'TH):	ADDL TOE WIDTH (TW):	'TOE 'THICKNESS (TTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: FDA

DATE: 12/18/2004
DATE: 12/10/04

RESISTING OVERTURNING		480,000	160,000	104,568,750	34,398,000	246,675,000	51,612,000	81,900,000	13,464,000	0	0	0	13,338,000	3,510,000	4,833,333	0	85,376,000	14,148,494	104,204,434		12,040,207	12,040,207 207,229,167
KE	_																					
ARM TO TOF:	· · · · · · · · · · · · · · · · · · ·	32.00	32.00	32.50	32.50	32.50	11.00	32.50	11.00	45.00	00.00	45.00	39.00	39.00	6.67	00.00	16.00	21.33	38.50	40.67	22 22	
LATI, FORCE:	E.I.																				סאט נאא א	001110010
WEIGHT:	LB	15,000	5,000	3,217,500	1,058,400	7,590,000	4,692,000	2,520,000	1,224,000	0	0	0	342,000	90,000	725,000	0	-5,336,000	-663,211	-2,706,609	-296,071		
STABILITY ANALYSIS:		CHANNEL GATE:	WALKWAY GATE:	CONCRETE PIERS:	UPPER STRUCTURE:	CHANNEL BLOCK FDN:	CHANNEL WEDGE FDN:	WALKWAY BLOCK FDN:	WALKWAY WEDGE FDN:	HEEL SLAB:	TOE SLAB:	FLUID ON HEEL:	FLUID ON CHANNEL SILL:	FLUID ON WALKWAY SILL:	FLUID ON D/S WEDGE:	FLUID ON TOE:	UPLIFT FORCE (U1):	UPLIFT FORCE (UZ):	UPLIFT FORCE (U3):	UPLIFT FORCE (U4):	TITTE HOPE TODGE (H).	FEDULD HONE FONCE (11)

STABILITY RESULTS:

= U* (WEIGHI CONC + GATES + WATER · UPLIFT)	= COHESION * BASE AREA	= DRIVING FORCES MINUS ACTIVE RESISTING FORCES	= [FRICTION + CONESION) / (NET SLIDING)		VE TO CL)	
6,568,794 LB	0 1.13	5,046,000 LB	1.30 >1.0?	1.45 >1.0?	7.21 (RELATIVE TO CL)	L(1+-6*E/L)
FRICTION FORCE (V*TAN(PHID))=	COHESION FORCE (CND*L*B)=	NET SLIDING FORCE =	SLIDING RATIO =	OVERTURNING RATIO (MR/MO)=	ECCENTRICITY $(E=L/2-(MR-MO)/V)$)=	BEARING PRESSURE = $V/L(1+-6*F/L)$

MAX BEARING PRESS = 9377 PSF MIN BEARING PRESS = 184 PSF VOLUME OF CONCRETE - 5,013 CY

Section 3 TRWD Isolation Gate StructuresRCC Foundation



TRWD Isolation Gate Structure

Usual Load Condition - SPF

(File I1 SPF-NoDrain-RCC TRWD.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at top of RCC.
- 3. Sliding Factor of Safety = 1.50
- 4. SPF level at El 540.0 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle on RCC = 45 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

BY: DESIGNED

CHECKED BY:

DATE: 12/18/2004 DATE: 12/20/04

SPF WATER ELEVATION (USUAL CONDITION)

GATE STRUCTURE STABILITY (W/ UPLIFT)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

PACTURE SOIL FRICTION ANGLE (PHI):
ACTURE SOIL COHESION (CN):
FLUID PRESS (EFP):
CONC UNIT WGT (CUM): GATE STRUCTURE: FLOOD ELEV (FE): TAILWATER ELEV (TE):

DEGREES PSF PCF

0 62.5 150

TOP OF PIER ELEV (PE): FDN BASE EL (BE):

550 FT 557 FT 496 FT 7.33 FT 98 FT 13 FT PIER LENGTH (PL):
PIER THICKNESS (PT):
NO. OF CONC PIERS (PN):
UPPER STRUCTURE OUTLINE (USO):

UPSTREAM FACE TO GATE CITE LINE (GCL):

DESIGN FRICTION ANGLE (PHID): RESULTING DESIGN VALUES & DIMENSIONS: 24 FT 518 FT 15,000 LBS CHANNEL GATE:
GATE WIDTH (CGW):
SILL ELEV (CSE):
GATE WEIGHT (CGWGT):

33.69 DEGREES 0 PSF 2750 PSF 1500 PSF

DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):

12 FT 530 FT 5,000 LBS GATE WIDTH (WGW): SILL ELEV (WSE): GATE WEIGHT (WGWGT):

ADDI, HEEL WIDTH (HW):
HEEL THICKNESS (HTH):
ADDI, TOE WIDTH (TW):
TOE THICKNESS (TTH):

FT FT FT 0002

CONCRETE WEDGE HEIGHT & LGTH (WH): 10 FT (WH = CSE-BE-TTH) FDN LENGTH (L): 35 FT (L IN + PL + WH + TW) FDN WIDTH (B): 58 FT

(II = CGW + WGW + PN*PT)

Il SPF-NoDrain-RCC TRWD.XLS

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DATE: 12/18/2004 DESIGNED BY: WCS

CHECKED

SD BY: COA	DATE:	DATE: 12/20/04			
STABILITY ANALYSIS:	WEIGHT: LB	LATL FORCE:	ARM TO TOE:	RESISTING MOMENT:	OVERTURNING MOMENT:
CHANNEL GATE: WALKWAY GATE:	15,000		22.00	330,000	
CONCRETE PIERS:	3,217,500		22.50	72,393,750	
CHANNEL BLOCK FUN:	3,795,000		22.50	85,387,500	
CHANNEL WEDGE FDN: WALKWAY BLOCK FDN:	1,530,000		22.50	34,425,000	
WALKWAY WEDGE FON:	306,000		5.50	1,683,000	
HEEL SLAB: TOE SLAB:	00		00.00	0	
FLUID ON MERL:	0		35.00		
FIGURE ON CHANNEL SILL: FLUID ON WALKWAY SILL:	342,000		29.00	2,610,000	
FLUID ON D/S WEDGE:	181,250		3. 8. 00.00	604,167	
UPLIET FORCE (U1):	-3,045,000		17.50		53,287,500
FLUID HORIZ FORCE (H): RESISTING FIGULD FORCE:		3,509,000	14.67	8,352,000	51,465,333
SUBTOTAL AT BASH (V, MR, MO) =	7,399,400	2,465,000		246,078,917	134,357,000

STABILITY RESULTS:

= U* (WEIGHT CONC + GATES + WATER UPLIFT)	- COHESTON * BASE AREA	= DRIVING FORCES MINUS ACTIVE RESISTING FORCES	(FRICTION + COHESION)/(NET SLIDING)		VE TO CL)				
4,932,933 LB	0 178	2,465,000 LB	2.00 >1.07	1.83 >1.0?	2.40 (RELATIVE TO CL)	V/L(1+-6*E/L)	5145 PSF	2145 PSF	2,736 CY
FRICTION FORCE (V*TAN(PHID))=	COMESION FORCE (CND*L*B)	NET SLIDING FORCE =	SLIDING RATIO =	OVERTURNING RATIO (MR/MO) =	ECCENTRICITY (E=L/2-(MR-MD)/V))	BEARING PRESSURE - V/L(1+-6*E/L)	MAX BEARING PRESS =	MIN BEARING PRESS	VOLUME OF CONCRETE =

TRWD Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-RCC TRWD.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at top of RCC.
- 3. Sliding Factor of Safety = 1.33
- 4. Maximum water level at El 544.0 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle on RCC = 45 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275-PRSTR.DCS

DESIGNED BY:

CHECKED BY: BOA

DATE: 12/18/2004 DATE: 12 20 04

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

1.33 45 DEGREKS 0 PSF 62.5 PCF 150 PCF ACTUAL SOLL FRICTION ANGLE (PHI): ACTUAL SOLL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUM): DESIGN PARAMETERS (INPUT): 520 FT 520 FT 557 FT 25 FT 7.33 FT 3 98 FT 13 FT GATE STRUCTURE: FLOOD RIEW (FE): TAILWATER BIEW (TE): TOP OF PIER RIEW (PE): FUN BASE EL (BE): PIER LENGTH (PL): PIER THICKNESS (PT): NO. OF CONC PIERS (PN): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CIR LINE (GCL):

		36.94 DECKERS	O PSF	3000 PSF	1000
RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID):	DESIGN COHESION (CND):	UPLIFT AT HEEL (UH):	
æ		24 FT	518 FT	15,000 LBS	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
	CHANNEL GATE:	GATE WIDTH (CGW):	STILL KLEY (CSE):	(HOMOS) PROTEIN GIVES	TOTAL MANAGEMENT OF THE PARTY O

GATE WEIGHT (CGWGT):	15,000 LBS	UPLIFT AT HEEL (UH): 3 UPLIFT AT TOE (UT): 1.	3000 PSF 1500 PSF
WALKWAY GATE:			
GATE WIDTH (WGW):	12 FT		
SILL FLEW (WSE):	530 FT	CONCRETE WEDGE HEIGHT & LGTH (WH):	10 FT
GATE WEIGHT (WGWGT):	S#T 000'S	L-AAA-AAAA HM)	TH)
		FDN LENGTH (L):	35 FT
ADDL HEEL WIDTH (HW):	() FT	(ML + HM + LP + PL + MH + TW)	HW)
HEEL THICKNESS (HTH):	0 1.1	FDN WIDTH (B):	SE FT
ADDL, TOE WIDTH ('IW):	() FT	(B = CGW + WGW + PM*	(Ld.
TOE THICKNESS (TTH):	12 17		

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR, DCS

DATE: 12/18/2004 CHECKED BY: DOL DESIGNED BY: WCS

DATE: 12/18/2004	DATE: 12/20 04

3,7,0 1,1,1 1,1,1 3,3,2	LATL FORCE: LB	ARM TO TOE:	RESISTING	OVERTURNING
ਅੰਦੇਅੰਦੇ	LB			
ਅੰਦੇਅੰਦੇ			MOMENT:	MOMENT:
memee		22.00	330,000	
mem de		22.00	110,000	
ਦੇਲਜੋਦ		22.50	72,393,750	
ਲੌਜੇਦ		22.50	23,814,000	
ਜੋਵ		22.50	85,387,500	
-		5.50	6,451,500	
		22.50	34,425,000	
m		5.50	1,683,000	
m		35.00	0	
m 		0.00	0	
Μ.		35.00	0	
		29.00	9,918,000	
FILE ON WALKWAY SILL: 90,000		29.00	2,610,000	
FLUID ON D/S WEDGE: 181,250		3.33	604,167	
FLUID ON TOE:		0.00	0	
UPLIFT FORCE (U1): -3,045,000		17.50		53,287,500
UPLIFT FORCE (U2): -1,522,500		23.33		35,525,000
FLUID HORIZ FORCE (H):	4,176,000	16.00		66,816,000
RESISTING FLUID FORCE:	-1,044,000	8.00	8,352,000	
SUBTOTAL AT BASE (V,MK,MO) 7,145,650	3,132,000		246,078,917	155,628,500

= U*(WEIGHT CONC + GATES + WATER - UPLIFT) = COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION) / (NET SLIDING) 0 CL)	
5,372,669 LB = U 0 LB = CO 3,132,000 LB = DI 1,72 > 1.0? 1,58 > 1.0? 4,84 (RELATIVE TO CL)	V/I,([+-6*E/L) 6442 PSF 598 PSF 2,736 CY
FRICTION FORCE (V*TAN(PHID)) COHESION FORCE (CND*1,*B) = NET SLIDING FORCE SLIDING RATIO = OVERTURNING RATIO = ECCENTRICITY (F=L/2-(NR-MO)/V)) =	BEARING PRESSURE VALUME OF CONCRETE = VOLUME OF CONCRETE =

STABILITY RESULTS:

TRWD Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-RCC-Base TRWD.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at base of RCC (approximate).
- 3. Sliding Factor of Safety = 1.33
- 4. Maximum water level at El 544.0 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle at rock = 35 degrees.

PROJECT: THWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DGS

DESIGNED BY: WCS

DATE: 12/18/2004

CHECKED BY: DDA

CHRCKED BY: CHANGE STABILITY (W/ UPLIFT)
GATH: STRUCTURE STABILITY (W/ UPLIFT)
MAXIMIM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 35 DECKRES 0 PSF 67.5 PCF 150 PCF	27.77 DEGRHES 0 PSF 4375 PSF 2875 PSF	774 (WH): 23 FU (WH = CSE-BE-TTH) FOTH (L):	WH + TW) 58 FT 7 + PN* P'I)
FACTOR OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (PHI): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFF): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HELGET & LGTH (WH): (WH = CSE FOR LENGTH (L):	(L = FW + PL + WH + TW) FDN WIDTH (B): 58 (B = CGW + WGW + PN*PT)
544 FT 520 FT 557 FT 25 FT 7.33 FT 7.33 FT 198 FT 13 FT 13 FT 13 FT 13 FT 13 FT 13 FT	24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS	2 FT 22 FT 0 FT 21 FT
GATE STRUCTURE: FLOOD RIEV (FE): TAILMATER ELEV (FE): TOP OF PIER ELEV (PE): FIEN LENGTH (PL): PIER THICKNESS (PT): NO. OF CONC PIERS (PT): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINE (GCL):	GATE GATE GATE WIDTH (CGW): SILL RLEV (CSE): GATE WEIGHT (CGWGT):	WALKWAY GATE: GATE WIDTH (WGW): SALL RIMY (WSE): GATE WEIGHT (WGWG!):	ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

PROJECT: TRWD . FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275 PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY:

DATE: 12/18/2004
DATE: 12/10/04

OVERTURNING MOMENT:	208,437,500	207,229,167	488,166,667		ER UPLIFT)
RESISTING MOMENT:	175,000 175,000 37,573,200 269,445,000 66,450,000 17,334,801 18,757,200 17,052,000 14,364,000 3,780,000 7,350,896	58,807,167	715,295,584		U* (WEIGHT CONC + CATES + WATTER
ARM TO TOK:	35.00 35.00 35.00 35.50 12.88 12.88 49.00 49.00 7.67 7.67 0.00	23,33			U* (WE) GIIT' CONC
LATL FORCE: LB		8,881,250	5,046,000		113
WEIGHT: LB	15,000 3,217,500 1,058,400 7,590,000 5,157,750 2,520,000 1,345,500 348,000 348,000 90,000		12,518,262		6.590.513 LB
STABILITY ANALYSIS:	CHANNEL GATE: WALKWAY GATE: CONCRETE PIERS: UPPER STRUCTURE: CHANNEL BLOCK FDN: CHANNEL WEDGE FDN: WALKWAY WEDGE FDN: WALKWAY WEDGE FDN: HEEL SLAB: FLUID ON CHANNEL SILL: FLUID ON WALKWAY SILL: FLUID ON D/S WEDGE: FLUID ON D/S WEDGE: FLUID ON POS: WALKWAY SILL: FLUID ON D/S WEDGE: FLUID ON TOE:	PLUID HORIZ FORCE (H): RESISTING FIJID FORCE:	SUBTOTAL AT BASE (V,MR,MO)	STABILITY RESULTS:	(CITIES) MARKAGES

COHESION * BASE AREA - COHESION * BASE AREA - DRIVING FORCES MINUS ACTIVE RESISTING FORCES - (FRICTION + COHESION) / (NET SLIDING)	IVE TO CL)		
6,5	1.47 >1.07 6.86 (RELATIVE TO CL)	494 8984 494 894	5,252
FRICTION FORCE (V*TAN(PHID)) COHESION FORCE (CND*1,*B) = NET \$LIDING FORCE SLIDING RATIO =	GVERTURNING RATIO (MR/MO): ECCENTRICITY (R=1/2-(MR-MO)/V))=	MAX BEARING PRESS = 7868 7868	MIN BEARING PRESS : VOLUME OF CONCRETE =

Section 4 TRWD Isolation Gate StructuresPile Foundation



TRWD Isolation Gate Structure Usual Load Condition - SPF

(File I1 SPF-NoDrain-Pile TRWD.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. SPF level at El 540.0 on driving side.
- 3. Tailwater at El 520.0 on resisting side.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/20/04 DATE: 12/18/2004

GATE STRUCTURE STABILITY (W/ UPLIFF)
SPF WATER ELEVATION (USUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 35 DEGREES 0 PSF 62.5 PCF 150 PCF	27.77 DEGREES 0 PSF 2750 PSF 1500 PSF	10 FT 5E-TTH) 35 PT MH (TW) 58 FT 4 PN*PT)
FACTOR OF SAFETY (FS): ACTUAL SOLL FRICTION ANGLE (PHI): ACTUAL SOLL COHESION (CN): FLUID PRESS (EFP): CUNC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HRIGHT & LGTH (WH): 10 (WH = CSE-BE-TTH) FDN LENGTH (L): 35 (L = HW + PL + WH + TW) FDN WIDTH (B): 58 (B = CGW + WGW + PN*PT)
540 FT 520 FT 557 FT 25 FT 7.33 FT 98 FT 13 FT	24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS 0 FT 0 IFT 12 FT
GATE STRUCTURE: FLOOD ELFV (FE): TAILWATER ELEV (TF): TOP OF PIER ELEV (PE): FOR BASE EL (BE): PIER INGTH (PI): PLER THICKNESS (PT): NO. OF CONC PIERS (PV): UPPER STRUCTURE OUTLINE (USO): UPPER STRUCTURE OUTLINE (USO):	CHANNEL GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	GATE WIDTH (WGW): SILL ELEV (WSE): GATH WEIGHT (WGWGT): ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDI, TOR WIDTH (TW): TOR THICKNESS (TTH):

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR, DCS

DATE: 12/18/2004 DESIGNED BY: WCS
CHECKED BY:

STABILITY ANALYSIS:

DAIE: 12/10/2004	DATE: 12 10 04
	,

				1	
	WEIGHT:	LATE FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	LB	LB		MOMENT:	MOMENT:
CHANNEL GATE:	15,000		22.00	330,000	
WALKWAY GATE:	5,000		22.00	110,000	
CONCRETE PIERS:	3,217,500		22.50	72,393,750	
UPPER STRUCTURE:	1,058,400		22.50	23,814,000	
CHANNEL BLOCK FON:	3,795,000		22.50	85,387,500	
CHANNEL WEDGE FON:	1,173,000		5.50	6,451,500	
WALKWAY BLOCK FDN:	1,530,000		22.50	34,425,000	
WALKWAY WEDGE FON:	306,000		5.50	1,683,000	
HEEL SLAB:	0		35.00	0	
TOE SLAB:	0		00.0	0	
FLUID ON HEEL:	0		35.00	0	
FLUID ON CHANNEL SILL:	342,000		29.00	9,918,000	
FLUID ON WALKWAY SILL:	90,000		29.00	2,610,000	
FLUID ON D/S WEDGE:	181,250		3.33	604,167	
FLUID ON TOE:	0		0.00	C	
UPLIFT FORCE (U1):	-3,045,000		17.50		53.287.500
UPLIFT FORCE (U2):	-1,268,750		23.33		29.604.167
FLUID HORIZ FORCE (H):		3,509,000	14.67		51.465.333
RESISTING FLUID FORCE:		1,044,000	8.00	8,352,000	
SUBTOTAL AT BASE (V,MR,MO)	7,399,400	2,465,000		246,078,917	134,357,000
STABILITY RESULTS:					

<pre>U*(WEIGHT CONC + GATES + WATER - UPLIFT) - COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESION) / (NET SLIDING)</pre>	10 CL)
3,895,576 LB 0 LB 2,465,000 LB 1.58 -1.02	2.40 (REMATIVE TO CL) 2.40 (REMATIVE TO CL) 5145 PSF 2145 PSF 2,736 CY
FRICTION FORCE (V*TAN(PHID))- COHESION FORCE (CND*L*B)= NET SLIDING FORCE = SLIDING RATIO = OVERTIRNING RATIO (MR.MO)=	ECCENTRICITY (E-1,/2-(MR-MO)/V))= 2.40 BEARING PRESSURE = V/L(1+-6*E/L) MAX BEARING PRESS = 5145 MIN BEARING PRESS = 2145 VOLUME OF CONCRETE = 2,736

TRWD Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-Pile TRWD.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Maximum water level at El 544.0 on driving side.
- 3. Tailwater at El 520.0 on resisting side.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: FLOAL

DATE: 12/18/2004

GATE STRUCTURE STABILITY (W/ UPLIFT) MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

ACTUAL SOIL PRICTION ANGLE (PHI): 35 DEGREES ACTUAL SOIL COHESION (CN): 0 PSF FLUID PRESS (EFP): 62.5 PCF CONC UNIT WGT (CUW): 150 PCF RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): 27,77 DEGREES DESIGN COHESION (CMD): 0 PSF UPLIFT AT HEEL (UH): 3000 PSF UPLIFT AT TOE (UT): 1500 PSF	CONCRETE WEDGE HEIGHT & LOTH (WH): 10 FT (WH = CSE-BE-1TH) FDM LENGTH (L): 35 FT	(D = 4M + PL + WH + W) FDN WIDTH (B): 58 FT (B = CGW + WGW + PN*PT)
544 PT 520 PT 557 PT 496 FT 25 PT 7.33 PT 3 98 PT	24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS	0 FT 0 FT 12 FT
GATE STRUCTURE: FLOOD BLEV (FE): TAILWATER BLEV (TE): TOP OF PIER BLEV (PE): FION BASE BL (BE): PIER LENGTH (PL): PIER THICKNESS (PT): NO. OF CONC PIERS (FN): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINE (GCL):	CHANNEL, GATE: GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	WALKWAY GATE: CATE WIDTH (WGW): SILL ELEV (WSE): GATE WEIGHT (WGWGT):	ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-422775-PRSTR.DCS

DESIGNED BY: WCS

CHRCKED BY: TEDUA

DATE: 12/18/2004 DATE: 12/20/4

RESISTING OVERTURNING MOMENT: 330,000 110,000 72,393,750 23,814,000 85,387,500 6,451,500 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	53,287,500 35,525,000 56,816,000 8,352,000	246,078,917 155,628,500	<pre>0**CONC + GATES + WATER - UPILET) COMESION * BASE AREA DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + CORESION) / (NET SLIDING)))))</pre>
ARM TO TOR: 22.00 22.50 22.50 22.50 22.50 5.50 5.50	0.00 17.50 23.33.3 000 16.00 8.00		TA* (WEIGHT CONC + GATE CONRSION * BASE AREA E DRIVING FORCES MINUS = (FRICTION + CONFSION FORCES IN TO CL.)
WEIGHT: LATL FORCE: L13 15,000 3,217,500 1,058,400 3,795,000 1,173,000 1,173,000 1,530,000 1,530,000 0 342,000 342,000 940,000 181,250	-3,045,000 -1,522,500 4,176,000 1,044,000	7,145,650 3,132,000	3,761,983 LB
CHANNEL GATE: CONCRETE PIERS: UPPIN STRUCTURE: CHANNEL BLOCK FDN: CHANNEL BLOCK FDN: CHANNEL WEDGE FDN: WALKWAY WEDGE FDN: WALKWAY WEDGE FDN: WALKWAY WEDGE FDN: FLUID ON WALKWAY SILL: FLUID ON WALKWAY SILL: FLUID ON WALKWAY SILL:	FLUID ON TOR: UPLIFT FORCE (UI): UPLIFT FORCE (UZ): FLUID HORIZ FORCK (II): BRESTERNO FULID FORCE:	SUBTOTAL AT BASE (V, MR, MO) = STABILITY RESULTS:	FRICTION FORCE (V*TAN(PHID)): 3,7 COMESTON FORCE (CND*H*B) = NET SHIDING FORCE = 3,1 SLIDING RATIO = OVERTURNING RATIO (NR/MO) = ECCENTRICITY (E=L/2*-(NR*MO)/V) = BEARING PRESSURE = V/L(1+MAX BEARING PRESS = VOITME OF CONCRETE:

TRWD Isolation Gate Structure Extreme Load Condition - Seismic

(File I3 SEISMIC-NoDrain-Pile TRWD.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Normal pool level at El 525.0 on driving side.
- 3. Tailwater at El 520.0 on resisting side.
- 4. Horizontal ground acceleration = 0.05 g.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: TSOM

DATE: 12/18/2004 DATE: 12/20/04

GATE STRUCTURE STABILITY (W/ UPLIFT) NORMAL POOL ELEVATION WITH SEISMIC (EXTREME CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.1 35 DEGREES 0 PSF 62.5 PCF 150 PCF 0.05 q	
PACTOR OF SAFETY (FS): ACTUAL SOLL FRICTION ANGLE (PHI): ACTUAL SOLL CORESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): SEISMIC COEFFICIENT (A):	RESULTING DESIGN VALUES & DIMENSIONS:
525 FT 520 FT 557 FT 496 FT 25 FT 7.33 FT	98 FT 13 FT
CATE STRUCTURE: PLOOD RLEV (FE): TOP OF PIER ELEV (PE): FUN BASE EL (BE): PIER LENGTH (PL): PIER THICKNESS (PT): NO. OF CONC PIERS (PN):	UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINE (GCL):

DESIGN FRICTION ANGLE (PHID): 32.48 DESFEES DESIGN COMESION (CND): 0 PSF UPLIFT AT HEEL (UH): 1813 PSF UPLIFT AT TOE (UT): 1500 PSF	CONCRETE WEDGE HEIGHT & LGTH (MH): (MH = CSE-BE-TTH) (MH = CSE-BE-TTH) (L = MH + PL + MH + TM) (D = CGM + MGM + PN*PT) (B = CGM + MGM + PN*PT)	SELSMIC PARAMETERS:
24 PT 518 PT 15,000 LBS	12 PT 530 FT 5,000 LBS 0 PT 0 FT 12 PT	
CHANNEL GATE: GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGNGT):	WALKWAY GATE: (ATE WIDTH (WGW): STAL BINY (WSE): GATE WEIGHT (WGWGT): ADDL HEEL WIDTH (HW): ADDL TOE WIDTH (TW): TOE WIDTH (TW):	

SEISMIC PARAMETERS:

SUM(DL) * A 0.4*(PE-BE)	0.67*51*A* (FE-BE) 2	0.4* (FE-BE)	OR 0.4* (TE-BE)
" "	36	46	OR
SEISMIC INERTIA DUE TO MASS = SUM(DL) * ASSUMED CENTROID OF MASS = 0.4*(PE-BE	CRETMIC FILID FORCE (PER WESTERGAARD)	LTANT ABOVE BASE	THE COURSE OF THE PROPERTY OF

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS

CHECKED BY: BOW

STABILITY ANALYSIS:

DATE: 12 10 04 DATE: 12/18/2004

	WELGHT	LATT, FORCE:	AKM TO TOE:	RESISTING	CVERTORNING
	LB	I,B		MOMENT:	MOMF:NT:
CHANNEL GATE:	15,000		22.00	330,000	
WALKWAY GATE:	5,000		22.00	110,000	
CONCRETE PIERS:	3,217,500		22.50	72,393,750	
UPPER STRUCTURE:	1,058,400		22.50	23,814,000	
CHANNEL BLOCK FDN:	3,795,000		22.50	85,387,500	
CHANNEL WEDGE FON:	1,173,000		5.50	6,451,500	
MALKWAY BLOCK FUN:	1,530,000		22.50	34,425,000	
WALKWAY WEDGE FDN:	306,000		5.50	1,683,000	
HEEL SLAB:	0		35.00	0	
TOE SLAB:	0		00.00	0	
FLUID ON HEEL:	C		35.00	C	
FLUID ON CHANNEL SILL:	342,000		29.00	9,918,000	
FIUID ON WALKWAY SILL:	90,000		29.00	2,610,000	
FLUID ON D/S WEDGE:	181,250		3,33	604,167	
FLUID ON TOE:	C		00.0	0	
UPLIFT FORCE (U1):	-3,045,000		17.50		53,287,500
UPLIFT FORCE (U2):	-317,187		23.33		7,401,042
FLUID HORIZ FORCE (H):		1,524,312	9.67		14,735,021
RESISTING FLUID FORCE:		-1,044,000	8.00	8,352,000	
SEISMIC INERTIA FORCE:		554,995	24		13,541,878
SEISMIC FLUID FORCE U/S:		1,437	11.6		16,667
SEISMIC FLUID FORCE D/S:		984	9.6		9,447
SUBTOTAL AT BASE (V, MR, MO)	8,350,962	1,037,728		246.078.917	מס מס

STABILITY RESULTS:

= U* (WEIGHT CONC + GATES + WATER - UPLIFT)	= COMESION * BASE AREA	= DRIVING FORCES MINUS ACTIVE RESISTING FORCES	= (FRICTION + COHESION) / (NET SLIDING)	
5,315,824 LB	0 1.8	1,037,728 LB	5.12 >1.0?	20 20 20
FRICTION FORCE (V*TAN(PHILD))	COHESTON FORCE (CND*L*B)=	NET SLIDING FORCE =	SLIDING RATIO	TON ONE OFFICE CHANGE THE OWNER OF THE OWNER OWNER OF THE OWNER OWN

COURTURING RATIO (MR/MO) = 2.77 >1.0?

ECCENTRICITY (B=L/2-(MR-MO)/V)) = -1.31 (RELATIVE TO CL)

BEARING PRESSURE . V/L(1-6*E/F)

MAX BEARING PRESS : 3189 PSF

MIN BEARING PRESS = 5038 PSF

VOLUME OF CONCRETE = 2,736 CY

Section 5 Trinity Point Isolation Gate StructuresMass Concrete Foundation



Trinity Point Isolation Gate Structure Usual Load Condition – SPF

(File I1 SPF-NoDrain-Mass TPoint.XLS)

- 1. Mass concrete foundation on rock.
- 2. Sliding Factor of Safety = 1.50
- 3. SPF level at El 545.5 on driving side.
- 4. Tailwater at El 520.0 on resisting side.
- 5. Friction angle at rock = 35 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DEBIGNED BY: WCS

CHECKED BY: DDA

DATE: 12/18/2004 DATE: 12 20 04

DIMENSIONS & WEIGHTS (INPUT):

GATE STRUCTURE STABLLITY (W/ UPLIFT) SPF WATER ELEVATION (USUAL CONDITION)

DESIGN PARAMETERS (INPUT):

1.5 35 DEGREES 0 PSF 62.5 PCF 150 PCF		25.02 DEGREES 0 PSF 5031 PSF 3438 PSF	35 FT E-TTH) 60 FT	+ TW) 80 FT pN*PT)
FACTOR OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (PHI): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW):	RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COMESION (CND): UPLIFT AT HEEL (UH): UPELIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LGTH (WH): 35 (WH = CSE-BE-TTH) FDN LENGTH (L): 60	(L = HW + PL + WH + TW) $FDN MIDTH (B): 80$ $(B = CGW + WGW + PN*PT)$
5.5 PT 520 FT 557 FT 465 PT 25 FT	8 FT 4 98 FT 13 FT	24 FT 518 FT 15,000 LBS	24 FT 530 FT 10,000 LBS	0 FT 0 FT 18 FT
GATE STRUCTURE: FLOOD ELEV (FE): 545.5 TAILWATER ELEV (TE): 520 TOP OF PIER ELEV (FE): 557 FUN BASE ELES: 465 FUN BASE (EE): 25	(PT): (PN): USO): GCI,):	CHANNEL GATE: GATE WIDTH (CCW): SILL BLEV (CSE): GATE WEIGHT (CGWGT): 15,	WALKWAY GATES: GATE WINTH - 2 GATES (WGW): SILL ELEV (WGE): GATE WEIGHT - 2 GATES (WGWGT): 10	ADDL HEEL WIDTH (MW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/18/2004 DATE: 12/10/04

STABILITY ANALYSIS:	WEIGHT:	LATL FORCE:	ARM TO TOE:	RESISTING	OVERTURNING MOMENT:
	E'I	I.B	1	000 301	
The state of the s	15,000		47.00	000,007	
CHANNELL CALE	000		47.00	470,000	
WALKWAY GATE:	000,01		47.50	222,300,000	
CONCRETE PIERS:	4,680,000		47.50	67,032,000	
UPPER STRUCTURE:	1,411,200		00.74	528.675,000	
CHANNEL BLOCK FIDN:	11,130,000		200	213,260,250	
CHANNEL WEDGE FON:	10,437,000		707	27.7 875,000	
WALKWAY BLOCK FDN:	5,850,000		00.70	01 797 250	
WALKWAY WEDGE FIN:	4,473,000		20.43	0	
HEEL SLAB:	С		00.09	c	
HOLD STAB	0		00.00	C (
TOE SINE:			60.00	0	
FLUID ON HEEL:			54.00	18,468,000	
FLUID ON CHANNEL SILL:	342,000		00. 43	9.720,000	
FLUID ON WALKWAY SILL:	180,000		20.50	35, 729, 167	
FLUID ON D/S WEDGE:	3,062,500		p. 0		
FLUID ON TOE:	0		000	:	495,000,000
HPLIFT FORCE (U1):	-16,500,000		30.00		153,000,000
HELTET FORCE (UZ) :	-3,825,000				424 716 771
(II) BOOOG BEAGE: STEEL		16,200,625	26.83		1
FLUID HOKIZ FORCE (F):		-7.562,500	18.33	138,645,833	
RESISTING FLUID FORCE:					
		301 357 0		1,604,277,500	1,604,277,500 1,082,716,771
SUBTOTAL AT BASE (V, MK, MO) =	21,765,700				

STABILITY RESULTS:

= U*(WEIGHT CONC : CATES : WATER UPLIFT) = COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES - (FRICTION + COHESION) / (NET SLIDING)
9,926,936 LB 0 LB 8,638,125 LB 1.15 >1.0?
FRICTION FORCE (V*TAN(PHID)) = COHESION FORCE (CND*L'B) = NET SLIDING FORCE : SLIDING RATIO

PCCENTRICITY (B=L/2-(MR-MO)/V)) = 1.48 >1.0?

EACCENTRICITY (B=L/2-(MR-MO)/V)) = 5.47 (RELATIVE TO CL)

BEARING PRESS = 6856 PSF

MIN BEARING PRESS = 2005 PSF

VOLUME OF CONCRETE = 9,378 CY

Trinity Point Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-Mass TPoint.XLS)

- 1. Mass concrete foundation on rock.
- 2. Sliding Factor of Safety = 1.33
- 3. Maximum water level at El 549.5 on driving side.
- 4. Tailwater at El 520.0 on resisting side.
- 5. Friction angle at rock = 35 degrees.

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY:

DATE: 12/18/2004 DATE: 12 20 04

GATE STRUCTURE STARTLITY (W/ UPLIFT) MAXIMUM WATER LEVEL TO TOP OF LEVER (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

ACTUAL SOIL FRICTION ANGLE (PHI): 35 DEGREES ACTUAL SOIL COHESION (CN): 0 PSF FLUID PRESS (EFP): 62.5 PCF CONC UNIT WGT (CUW): 150 PGF	DESIGN FRICTION ANGLE (PHID): 27.77 DEGREES DESIGN COHESION (CND): 0 PSF UPLIFT AT HEEL (UH): 5281 PSF UPLIFT AT TOE (UT): 3438 PSF	CONCRETE WEDGE MEIGHT & LGTH (WH): (WH: CSE-BE-TTH) FIN LENGTH (L):	FDN WDTH (B): 80 FT. $FDN WDTH (B): 80 FT.$ $FDN WDWH FN*PT.$
249.5 553 14 653 465 12 25 14 8 17 8 19 8 13 8 17 13 8	24 FT 518 FT 15,000 LBS	24 FT 530 FT 10,000 LBS	0 FT 0 FT 0 FT 18 TH
GATE STRUCTURE: FLOOD RLEV (FK): TOP OF PIER RLEV (FE): FLOO PRES EL (BK): PLER LENGTH (PL): PLER THICKNESS (FT): NO. OF CONC PIRKS (FT): NO. OF CONC PIRKS (FT): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTM LINE (GCL):	CHANNEL GATE: GATE WIDTH (CCM): SILI, ELEY (CSE): GATE WEIGHT (CGWCT):	GATE WIDTH - 2 GATES (NGW): SILL FLEV (NGR): GATE WEIGHT 2 GATES (WGMGT):	ADDL HEEL WIDTH (HW): HEEL, TWICKNESS (HTH): ADDL, TOR WIDTH (TW): TOE THICKNESS (T'H):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: CHECKED BY:

DATE: 12/18/2004 DATE: 12/20/04

	WEIGHT:	LATL FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	LB	L B		MOMENT:	MOMENT
CHANNEL GATE:	15,000		47.00	705,000	
WALKWAY GATE;	10,000		47.00	470,000	
CONCRETE PIERS:	4,680,000		47.50	222,300,000	
UPPER STRUCTURE:	1,411,200		47.50	67,032,000	
CHANNEL BLOCK FIN:	11,130,000		47.50	528,675,000	
CHANNEL WEDGE FDN:	10,437,000		20.43	213,260,250	
WALKWAY BLOCK FDN:	5,850,000		47.50	277,875,000	
WALKWAY WEDGE FUN:	4,473,000		20.43	91,397,250	
HEEL SLAB:	0		00.09	0	
TOE SLAB:	0		00.00	0	
FLUID ON MEEL:	0		60.00	0	
FLUID ON CHANNEL SILL:	342,000		54.00	18,468,000	
FLUID ON WALKWAY SILL:	180,000		54.00	9,720,000	
FLUID ON D/S WEDGE:	3,062,500		11.67	35,729,167	
FLUID ON TOE:	0		0.00	0	
UPLIMT FORCE (U1):	-16,500,000		30.00		495,000,000
UPLIFT FORCE (U2):	4,425,000		40.00		177,000,000
FLUID HORIZ FORCE (H):		17,850,625	28.17		502,792,604
RESISTING FLUID FORCE:		-7,562,500	18.33	138,645,833	
SUBTOTAL AT BASE (V, MR, MO) =	20,665,700	10,288,125		1,604,277,500 1,174,792,604	1.174.792.604

U*(WEIGHT CONC + GATES + WATER - UPLIFT)
= COHESION * BASE AREA
DRIVING FORCES MINUS ACTIVE RESISTING FORCES
= (FRICTION + COHESION) / (NET SLIDING) STABILITY RESULTS:

Trinity Point Isolation Gate Structure (with Drains) Unusual Load Condition - Max Water Level

(File I2 MAX-Drain-Mass TPoint.XLS)

- 1. Mass concrete foundation on rock, with foundation drainage system.
- 2. Maximum water level at El 549.5 on driving side.
- 3. Tailwater at El 520.0 on resisting side.
- 4. Drains 33 percent effective, 10-ft downstream of headwall.

PROJECT: TRWD FLOOD GATE CONTROL STRUCFURE

CHARGE NO.: 2521-4227/5-PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY:

DATE: 12/18/2004 DATE: 12/10/04 GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITTON)

DESIGN PARAMETERS (INPUT):

DIMENSIONS & WEIGHTS (INPUT):

DEGREES PSF PCF PCF FT	
1.33 35 0 62.5 150 10.33	
ACTUAL SOLE FRICTION ANGLE (PHI): ACTUAL SOLE COHESION (CN): FLUID PRESS (EFP): CONC UNIT WOT (CUW): DRAIN BEFICIENCY (DE): DHAIN DIMENSION FROM HEADWALL (DD):	RESULTING DESIGN VALUES & DIMENSIONS:
Test that the test th	FT RES
549.5 520 557 465 25 8	13
GATE STRUCTURE: FLOOD BLEV (FE): TOP OF PIER BLEV (PE): FON BASE EL (BE): PIER LENGTH (PL): PIER THICKNESS (FT): NO. OF CONC PIERS (PV):	UPSTREAM FACE TO GATE CTR LINE (GCL):

RESULTING DESIGN VAL

DESIGN FRICTION ANGLE (PHID): 27.77 DEGREES DESIGN COMESION (CND): 0 PSF UPLIFT AT HEEL (UH): 5281 PSF UPLIFT AT TOR (UT): 3438 PSF UPLIFT AT DRAIN (UI): 4460 PSF	CONCRETE WEDGE HEIGHT & LGTH (WH): 33 FT (WH = CSE-BE-TTH) FDN LENGTH (L): 58 FT	$\{L = HW + PL + MR + PT \}$ $\{B = CGW + WGW + PW + PT \}$
24 PT 518 FT 15,000 LBS	24 FT 530 FT 10,000 LHS	0 FT 0 FT 20 FT
CHANNEL GATE: GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	WALKNAY GATES: GATE WINTH - 2 GATES (WGW): SILL ELEV (WSE): GATE WEIGHT - 2 GATES (WGWGT):	ADDL HEEL WIDTH (HW): HEEL TRICKNESS (HTH): ADDL TOE WIDTH (TW): HOP THICKNESS (TTH):

PROJECT: THWD - FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS

CHECKED BY: 7304

DATE: 12/18/2004

OVERTURNING MOMENT:								316,800,000	189,096,690	502,792,604	1,521,748,673 1,089,462,871
RESISTING MOMENT:	450,000	64,209,600	506,415,000	266,175,000	00	17,784,000	9,360,000	0		138,645,833	1,521,748,673
ARM TO TOE:	45.00	45.50	45.50	19.04	0.00	58.00	52.00	24.00	53.00		
LATL FORCE: LB										17,850,625 -7,562,500	10,288,125
WEIGHT: LB	15,000	4,680,000	11,130,000	5,850,000	4,336,200		180,000	-13,200,000	-1,962,869	000 1070	21,735,400
STABILITY ANALYSIS:	CHANNEL GATE:	CONCRETE PIERS:	CHANNEL BLOCK FIDN:	CHANNEL WEDGE FON: WALKWAY BLOCK FDN:	WALKWAY WEDGE FUN: HEEL SLAB:	FIUID ON HEED:	FLUID ON WALKWAY SILL:	FLUID ON D/S WEDGE: FLUID ON TOE: UPLIFT FORCE (UI):	UPLIFT FORCE (U2): UPLIFT FORCE (U3):	UPLIFT FORCE (U4): FLUID HORIZ FORCE (H): RESISTING FLUID FORCE:	SUBTOTAL AT BASE (V, MR, MO)

STABILITY RESULTS:

U*(WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA . DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION)/(NET SLIDING) TO CL.)
11,443,076 LB
FRICTION FORCE (V*TAN(PHID)) = 11,443,076 I COHESION FORCE (CNI)*L*B) = 0 SLIDING FORCE 10,288,125 I SLIDING RATIO 1.111 OVERTURNING RATIO (MR/MO) = 1.40 ECCENTRICITY (E=L/2-(MR-MO)/V) = 9.11 MAX BEARING PRESSUR = V/L(1+6*F/L) MAX BEARING PRESS = 269 WIN BEARING PRESS = 269

Section 6 Trinity Point Isolation Gate StructuresRCC Foundation



Trinity Point Isolation Gate Structure Usual Load Condition - SPF

(File I1 SPF-NoDrain-RCC TPoint.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at top of RCC.
- 3. Sliding Factor of Safety = 1.50
- 4. SPF level at El 545.5 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle on RCC = 45 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DATE: 12/18/2004 DATE: 12 20 OU

DESIGNED BY: WCS
CHECKED BY:

GATE STRUCTURE STABILITY (W/ UPLIFT) SPF WATER ZLEVATION (USUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

	1.5	45 DEGREES	PSF 0	62.5 PCF	150 PCF							33.69 DEGREES	O PSF	2281 PSF	688 PSF			P FT	-BE-TTH)	34 F'J'	WH I TW)	80 FT	+ PN*PT)	
	FACTOR OF SAFETY (FS):	ACTUAL SUIL FRICTION ANGLE (PHI):	ACTUAL SOIL COMESION (CN):	FLUID PRESS (RFP):	CONC UNIT WGT (CUW):					RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID):	DESIGN COHESION (CND):	UPLIFT AT HEEL (UH):	UPLIFT AT TOE (UT):			CONCRETE WEDGE HEIGHT & LGTH (WII) :	(WH = CSE-BE-TTH)	FUN LENGTH (I.):	(L = HW + PL + WH + TW)	FDN WIDTH (B):	(B = CGW + WGW + PN*PT)	
	545.5 FT	520 F'L	557 FT	509 FT	25 FT	8 FT	4	98 FT	13 F.T			24 FT	518 FT	15,000 LBS			24 FT	530 FT	10,000 LHS			() FT	0 F'I'	T.1 0
GAT'R STRUCTURE:	FLOOD ELEV (FE):	'TAILWATER ELEV (TE):	TOP OF PIER KLEV (PH):	FON BASK EL (BE):	PIER LENGTH (PL):	PIER THICKNESS (PT):	NO. OF CONC PIERS (PN):	UPPER STRUCTURE OUTLINE (USO):	UPSTREAM FACE TO GATE CUR LINE (GCL.):		CHANNEL GATIVE	CATE WINTH (CCW):	SILL ELLV (CSE):	GATE MEIGHT (CGWGT):		WALKWAY GATES:	GATE WIDTH - 2 GATES (WGW):	SILL ELEV (WSE):	GATE WRIGHT - 2 GATES (WGWGT):		ADDL NEEL WIDTH (HW):	HEEL THICKNESS (HTH):	ADDL TOE WIDTH (TW):	THICKNESS (TIH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHRCKED BY: WCS

DATE: 12/18/2004

OVEKTURNING MOMENT:	31,790,000 49,130,000 40,522,604	121,442,604
RESISTING MOMENT: 315,000 210,000 100,620,000 30,340,800 40,635,000 2,051,406 40,635,000 879,174 0 9,576,000 5,040,000	607,500	1,109,16/ 232,019,047
ARM TO TOE: 21.00 21.50 21.50 21.50 21.50 6.03 34.00 34.00 28.00	3.00 0.00 17.00 22.67 12.17	3.67
LAIL FORCE:	3,330,625	
WEIGHT: 15,000 4,680,000 1,411,200 1,890,000 1,890,000 1,890,000 1,890,000 340,200	180,000 202,500 0 .1,870,000 -2,167,500	7,069,200
CHANNEL GATE: CHANNEL GATE: CONCRETE PIERS: UPPER STRUCTURE: CHANNEL BLOCK FDN: CHANNEL WEDGE FDN: WALKWAY BELOCK FDN: WALKWAY BLOCK FDN: WALKWAY BLOCK FDN: WALKWAY BLOCK FDN: WALKWAY BLOCK FDN: TOB SLAB: FLUID ON HEEL: FLUID ON CHANNEL SILL:	FIGURE ON WALKWAY SILL: FIGURE ON D/S WEDGE: FIGURE ON TOE: UPLIFT FORCE (UI): UPLIFT FORCE (UZ):	RESISTING FLUID FORCE: SUBTOTAL AT BASE (V, MR, MO)

STABILITY RESULTS:

8001	= U*(MEIGHT CONC + GATES + WATER - UPLIFT) = COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION)/(NET SLIDING) VE TO CL)
STABLIST STABLIST	FRICTION FORCE (V*TAN(PHID)) = 4,712,800 LB = 0.0 LB
	PRICTION FO COMESIC NOVERTURE ECCENTRICITY

Trinity Point Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-RCC TPoint.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at top of RCC.
- 3. Sliding Factor of Safety = 1.33
- 4. Maximum water level at El 549.5 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle on RCC = 45 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 60A

DATE: 12/18/2004 DATE: 12/20/04

GATE STRUCTURE STABILLTY (W/ UPLIFT)
MAXIMUM WATER LEVER TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

S): 1.33 45 DECKEES N): 62.5 PCF M): 150 PCF M): 150 PCF	AID): 36.94 DEGREES CND): 0 PSF (UH): 2531 PSF (UT): 688 PSF	T & LCTH (WH): 9 PT (WH : CSE BF TTH) DN LENGTH (L): 34 FT (L = HW + PL + WH + TW) FDN MIDTH (B): 80 FT (B = CGW + WGW + PN*PF)
FACTOR OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (PH4): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN CORESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGIE HELGIT & LGTH (WH): (WH : CSF PDN LENGTH (L): (L = HM + PL + FDN WLDTH (B): (B = CGM + WGW
549.5 FT 520 FT 557 FT 509 PT 25 FT 8 PT 4 9 RT 13 FT	24 FT 518 FT 15,000 LBS	24 FT 530 FT 10,000 LBS 0 FT 0 FT 0 FT
GATE STRUCTURE: PLOOD ELEV (FK): TAILMATER ELEV (FE): TOP OF PIER ELEV (FE): PIER LANGTH (FL): PIER THICKNESS (FT): NO. OF CONC PIERS (FV): UPPER STRUCTURE OUTLINE (USO): UPSTEREAM FACE TO GATE CTW LINE (GCI):	CHANNEL GATE: GATE WIDTH (CGW): SILL RLEV (CSR): GATE WEIGHT (CGWGT):	WALKWAY GATES: GATE WIDTH - 2 GATES (WGW): SILL ELEV (WSF): GATE WEIGHT 2 GATES (WGWGT): ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS
CHECKED BY: CDM

12/18/2004	12/20/04
DA'TE:	DATE:
	!

CTCITVIN ILTTICUTO					
	WETCHT:	LATL FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	E.I.	I,B		MOMENT:	MOMEN'I:
CHANNEL GATE:	15,000		21.00	315,000	
WALKWAY GATE:	10,000		21,00	210,000	
CONCRETE PIERS:	4,680,000		21,50	100,620,000	
UPPER STRUCTURE:	1,411,200		21.50	30,340,800	
CHANNEL BLOCK FDN:	1,890,000		21.50	40,635,000	
CHANNEL WEDGE FDN:	340,200		6.03	2,051,406	
WALKWAY BLOCK FDN:	1,890,000		21.50	40,635,000	
WALKWAY WEDGE FUN:	145,800		6.03	879,174	
HEEL SLAB:	0		34.00	0	
TOE SLAB:	0		00.00	0	
FLUID ON HEEL:	0		34.00	0	
FLUID ON CHANNEL SILL:	342,000		28.00	9,576,000	
FLUID ON WALKWAY SILL:	180,000		28.00	5,040,000	
FLUID ON D/S WEDGE:	202,500		3.00	607.500	
FLUID ON TOE:	0		0.00		
UPLIFT FORCE (U1):	-1,870,000		1.7.00		31.790.000
UPLIFT FORCE (U2):	-2,507,500		22.67		56.836.667
FLUID HORIZ FORCE (II) :		4,100,625	13.50		55,358,438
RESISTING FIUID FORCE:		-302,500	3.67	1,109,167	
SUBTOTAL AT BASE (V,MK,MO)=	6,729,200	3,798,125		232,019,047	143,985,104
CERTIFICATION OF THE PROPERTY					
STABLLI KESULTS:					

= U* (WEIGHT CONC + GATES + WATER - UPLIFT) = COHESION * BASE AREA URIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION)/(NET SLIDING)
5,059,549 lb = U 0 LB
FRICTION FORCE (V*TAN(PHID)) 5,059,549 COHESION FORCE (CND*L*B) 0 NET SLIDING FORCE 3,798,125 SLIDING RATIO = 1.33 OVERTURNING RATIO (MR/MO) = 1.61 ECCENTRICITY (FEL/2-(MR-MO)/V)). 3,92 BEARING PRESSURE = V/L(1+·6*F/L) MAX BEARING PRESS = 764 MIN BEARING PRESS = 764 VOLUME OF CONCRETE = 2,557

Trinity Point Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-RCC-Base TPoint.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at base of RCC (approximate).
- 3. Sliding Factor of Safety = 1.33
- 4. Maximum water level at El 549.5 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle at rock = 35 degrees.

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: MCS
CHECKED BY:

CHECKED BY:

DATE: 12/18/2004 DATE: 12/20/04

DESIGN PARAMETERS (INPUT):

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMIM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

1.33 35 DWGREES 0 PSF 62.5 PCF 150 PCF	27.77 DEGREES 0 PSF 5281 PSF 3438 PSF	33 FT -BE-TTH) 60 FT -WH + TW) 80 FT + PN*PT)
FACTOR OF SAFETY (FS): ACTUAL SOIL COHESION (CN): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LOTH (WH): RN = CSE-BE-TTH) RL = HW + PL + WH + TW FDW WIDTH (B): RO RD = CGW + WGW + PN*PT)
549.5 PT 520 FT 465 FT 25 FT 8 FT 8 FT 13 FT	24 FT 518 FT 15,000 LBS	24 FT 530 FT 10,000 LBS 2 FT 44 FT 0 FT 20 FT
GATE STRUCTURE: FLOOD BLEV (FE): TOP OF PIER ELEV (FE): FDN BASE EL (BE): PIER ILENGTH (PL): PIER THICKNESS (PT): NO. OF CONC PIERS (PN): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINE (GCL):	CHANNEL GATE: GATE WIDTH (CGN): SILL ELEV (CSE): GATE WRIGHT (CGWGT):	GATE WIDTH 2 GATES (WGW): STLL ELEV (WSE): GAUE WEIGHT 2 GATES (WGWCI): ADDL NEEL WIDTH (HW): HREL THICKNESS (HTH): ADDL TOF WIDTH (TW): TOF THICKNESS (TIH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS
CHECKED BY: 73DM

DATE: 12/18/2004 DATE: 12/22/24

495,000,000 177,000,000 502,792,604 OVERTURNING MOMENT: 1,607,947,673 1,174,792,604 64,209,600 506,415,000 192,602,718 266,175,000 82,544,022 62,304,000 23,895,000 17,784,000 9,360,000 29,947,500 RESISTING 675,000 450,000 212,940,000 138,645,833 MOMENT: 45.00 45.00 45.00 45.50 119.04 45.50 50.00 50.00 11.00 10.00 LATL FORCE: ARM TO TUE: 17,850,625 E. 10,288,125 15,000 1,680,000 1,411,200 11,130,000 10,113,000 5,850,000 4,336,200 1,056,000 342,000 180,000 2,722,500 21,330,700 WEIGHT: 405,000 -16,500,000 -4,425,000 CHANNEL WEIGE FON: WALKWAY BLOCK FON: WALKWAY WEDGE FON: HEEL SLAB: TOE SLAB: SUBTOTAL AT BASE (V, MK, MO) = UPLIFT FORCE (U1): UPLIFT FORCE (U2): FLUID MORIZ FORCE (H): RESISTING FLUID FORCE: FIUID ON CHANNEL SILL: FLUID ON WALKWAY SILL: FLUID ON D/S WEDGE: FLUID ON TOE: FIGUID ON HEEL: STABILITY ANALYSIS: CHANNEL GATE: WALKWAY GATE: CONCRETE PIERS: UPPER STRUCTURE: CHANNEL BLOCK FDN:

STABILITY RESULTS:

U* (WEIGHT CONC + GATES + WATER - UPLIFT)	COHESION * BASE AREA	= DRIVING FORCES MINUS ACTIVE RESISTING FORCES	FRICTION + COHESION) / (NFT SLIDING)		TO CL)					
11,230,013 LB	0 18	10,288,125 LB	1.09 >1.0?	1.37 >1.0?	9.69 (RELATIVE TO CL)	/L(1+-6*E/L)	8752 PSF	136 PSF	9,526 CY	
FRICTION FORCE (V*TAN(FHID)): 11,230,013 LB	COHESION FORCE (CND*L*B)=	NET SLIDING FORCE -	SLIDING RATIO =	OVERTURNING RATIO (MR/MO) =	ECCENTRICITY (E=1/2-(MR-MO)/V))=	BEARING PRESSURE = V/L(1+-6*E/L)	MAX BEARING PRESS =	MIN REARING PRESS =	VOLUME OF CONCRETE =	

Section 7 Trinity Point Isolation Gate StructuresPile Foundation



Trinity Point Isolation Gate Structure Usual Load Condition - SPF

(File I1 SPF-NoDrain-Pile TPoint.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. SPF level at El 545.5 on driving side.
- 3. Tailwater at El 520.0 on resisting side.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

DATE: 12/18/2004 DATE: 12 10 04

CHECKED BY: DDA

CAPE STRUCTURE STABILITY (W/ UPLIFT) SPE WATER ELEVATION (USUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 35 DECREES 0 PSF 62.5 PCF 150 PCF	27.77 DEGREES 0 PSF 2281 PSF 688 PSF	6 PT HE TTW)
FACTOR OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (PHI): ACTUAL SOIL COMESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUM): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CNI): UPLIFT AT HEEL (UII): UPLIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LATH (WH): 6 (WH = CSE-HE TTH) FON LENGTH (L): 37
THE	FT FT	FT
745.58 8.20 8.20 8.20 8.20 8.20 8.20 8.20 8.2	24 FT 518 FT 15,000 LBS	24 FT 530 FT 10,000 LBS
GATH STRUCTURE: FLOOD ELEV (FE): TALLMATER ELEV (TE): TOP OF PIER ELEV (PE): FON BASE EL (BE): PIER LENGTH (PL): PIER THICKNESS (PT): NO. OF CONC PIERS (PN): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINE (GCL):	CHANNEL GATE: GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	GATE WINTH - 2 GATES (WGW): SILL ELEV (WSE): GATE WEIGHT - 2 GATES (WGWGT):

CONCRETE WEDGE HEIGHT & LATH (WH): 6 PT

(WH = CSE-HE TTH)

PDN LENGTH (L): 37 FT

(L = HW + PL + WH + TW)

FIN WIDTH (B): 80 FT

(B CGW + WGW + PN*PT)

4 FT 3 FT 2 FT 3 FT

ADDL HEEL WIDTH (HW):
HEEL THICKNESS (HTH):
ADDL TOE WIDTH (TW):
TOE THICKNESS (TTH):

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS

CHACKED BY:

12/18/2004	12/20/04
DATE:	DATE:
	1

D BY:	DATE:	DATE: 12/00/07			
STABILITY ANALYSIS:					
	WEIGHT:	LATL FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	H.I.	E'1		MOMENT	MOMENT:
CHANNEL GATE:	15,000		20.00	300,000	
WALKWAY GATE:	10,000		20.00	200,000	
CONCRETE PIERS:	4,680,000		20.50	95,940,000	
UPPER STRUCTURE:	1,411,200		20,50	28,929,600	
CHANNEL BLOCK FUN:	1,890,000		20.50	38,745,000	
CHANNEL WEDGE FUN:	302,400		5.51	1,656,224	
WALKWAY BLOCK FON:	1,890,000		20.50	38,745,000	
WALKWAY WEDGE FUN:	129,600		5,51	714,096	
HEEL SLAB:	144,000		35.00	5,040,000	
TOE SLAB:	72,000		1.00	72,000	
FLUID ON HEEL:	670,000		35.00	23,450,000	
FLUID ON CHANNEL SILL:	342,000		27.00	9,234,000	
FLUID ON WALKWAY SILL:	180,000		27.00	4,860,000	
FLUID ON D/S WEDGE:	000,06		4.00	360,000	
FLUID ON TOP:	80,000		1.00	80,000	
UPLIFT FORCE (U1):	-2,035,000		18.50		37,647,500
UMLIFT FORCE (UZ):	-2,358,750		24.67		58.182.500
FLUID HORIZ FORCE (H):		3,330,625	12.17		40,522,604
RESISTING FLUID FORCE:		302, 500	3.67	1,109,16/	
SUBTOTAL AT BASE (V, MR, MO) =	7,512,450	3,028,125		249,445,087	1.36,352,604

= U* (WEIGHT CONC + CATES + WATTER - UPLIFT)	COHESION * BASE AREA	= DRIVING FORCES MINUS ACTIVE RESISTING FORCES	(FRICTION + COMESION) / (NET SLIDING)		(CL)				
3,955,093 18	0 13	3,028,125 LB	1.31 >1.03	1.83 >1.0?	3.45 (RELATIVE TO CL)	V/I.(1,+-6*E/L)	3956 PSW	1120 PSF	2,597 CX
FRICTION FORCE (V*TAN(PHID))	CONESTON FORCE (CND*L*B)=	NET SLIDING FORCE	SLIDING RATIO =	OVERTURNING RATIO (MR/MG)	ECCENTRICITY (E=L/2-(MR-NO)/V)).	BEARING PRESSURE = V/I, (1,+-6*E/L)	MAX BEARING PRESS	MIN BEARING PRESS =	VOLUME OF CONCRETE

STABILITY RESULTS:

Trinity Point Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-Pile TPoint.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Maximum water level at El 549.5 on driving side.
- 3. Tailwater at El 520.0 on resisting side.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED HY: 930A

DATE: 12/18/2004

DATE: 12 (20)04

GATE STRUCTURE STABILITY (W/ UPLIFT) MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DESIGN PARAMETERS (INPUT):

DIMENSIONS & WEIGHTS (INPUT):

DEGREES PSF PCF	27.77 DEGREES 0 PSF 2531 PSF 688 PSF	6 FT TT) 37 FT TW) 80 FT
1.33 35 0 62.5 150	252.2	E-BE-T WH + + PN'
(FB): (PHI): (CFP): (CFP): (CFP):	(PHID): (CND): L (UH): E (UT):	### ### ##############################
ACTUAL SOIL PRICTION ANGLE (PHI): ACTUAL SOIL COHESION (CN): PLUID PRESS (EPP): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LGTH (WH) = GS: FDN LENGTH (L): (L = HW + PL + FDN WIDTH (B): (B = CGW + WGW
25 FT 552 FT 557 FT 509 FT 8 FT 4 8 FT 13 FT	24 FT 518 FT 15,000 LBS	24 PT 530 PT 10,000 LBS 4 PT 3 PT 2 FT 3 FT
GATE STRUCTURE: FLOOD ELEV (FE): 549.5 TALMATER ELEV (FE): 520 TOP OF PIER ELEV (FE): 557 PIER LENGTH (PL): 25 PIER THICKNESS (FT): 8 NO. OF CONC PIERS (FN): 4 UPSTREAM FACE TO GATE CTR LINE (GCL): 13	CHANNEL GATE: GATE WIDTH (CGW): SILL ELRY (CSE): GATE WEIGHT (CGWGT): 15	WALKWAY GATES: GATE WIDTH - 2 GATES (WGW): SILL ELEV (WSE): GATE WEIGHT - 2 GATES (WGWGT): ADDL HEEL WIDTH (HW): IREL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

PROJECT: TRWD - PLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS
CHECKED BY: 12/19/2004

	OVERTURNING	: TANGETON															37,647,500	67,309,167	55,358,438		160,315,104		UPLIFT) TING FORCES G)
	RESISTING OV	300.000	200,000	95,940,000	28,929,600	38,745,000	1,666,224	38,745,000	714,096	5,040,000	72,000	26,250,000	9,234,000	4,860,000	360,000	80,000		9	. ru	1,109,167	252,245,087 16		U*(WEICHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESION)/(NET SLIDING)
	ARM TO TOE:	20.00	20.00	20.50	20.50	20.50	5.51	20.50	5.51	35.00	1.00	35.00	27.00	27.00	4.00	1.00	18.50	24.67	13.50	3.67			U*(WEIGHT CONC + GAT COHESION * BASE AREA DRIVING FORCES MINUS (FRICTION * COHESION))
	LATL FORCE:																		4,100,625	-302,500	3,798,125		1,416 LB = L 0 LB = C 1,125 LB = C 1,00 > 1,0? = C 1,57 > 1,0? = C 1,57 > 1,0? = C 1,57 PSF
	WEIGHT:	15,000	10,000	4,680,000	1,411,200	1,890,000	302,400	1,890,000	129,600	144,000	72,000	1,50,000	342,000	180,000	90,000	80,000	-2,035,000	2,728,750			7,222,450		3,802,416 LB 0 LB 3,798,125 LB 1.00 >1.0? 1.57 >1.0? 5.77 (RELA) /L(1+-6*F/L) 1.54 PSF
- OFFICE VETTERS		CHANNEL GATE:	WALKWAY GATE:	CONCRETE PIERS:	UPPER STRUCTURE:	CHANNEL BLOCK FON:		BLOCK	WALKWAY WEDGE FDN:	HEEL SLAB:	TOR SLAB:	FIGIL ON MEEL:	FI,UID ON CHANNEL SILL:	FLUID ON WALKWAY SILL:	FLUID ON DAS WEDGE:	FLUID ON TOE:	UPLIFT FORCE (U1):	UPLIFT FORCE (UZ):	FLUID HOMIN FORCE (N):	RESISTING FINID FORCE:	SUBTOTAL AT BASE (V, MR, MO)	STABILITY RESULTS:	FRICTION FORCE (V*TAN(PHID)) COHESIEN FORCE (CND*L*B.)= NEW SLIDING FORCE = 3,798,125 SLIDING FARTO = 1.00 OVERTURNING RATIC (MR/MQ)*= 1.57 ECCENTRICITY (E=L/2-(NR-MQ)/V)) = 5.77 BEARING PRESSURE = V/L(1+-6*F/L) MAN BERRING PRESS = 4724

Trinity Point Isolation Gate Structure Extreme Load Condition - Seismic

(File I3 SEISMIC-NoDrain-Pile TPoint.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Normal pool level at El 525.0 on driving side.
- 3. Tailwater at El 520.0 on resisting side.
- 4. Horizontal ground acceleration = 0.05 g.

PROJECT: TRWD - FLOOD GATE CONTROL, STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 9304

DATE: 12/20/04 DATE: 12/18/2004

GAUE STRUCTURE STABILITY (W/ UPLIFT)
NORMAL POOL ELEVATION WITH SETSMIC (ENTREME CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DEGREES PSF PCF 1.1 35 0 62.5 150 0.05 ACTUAL SOLL FRICTION ANGLE (PHI): ACTUAL SOLL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUM): SEISMIC COEFFICIENT (A) FT FT FT FT 525 520 557 557 25 8 8 4 4 GATE STRUCTURE: FLOOD ELEV (FE): TOTLWATER ELEV (FE): TOP OF PLER ELEV (FE): PRN BASE EL (BR): PLER LENGTH (PL): NO. OF CONC PIERS (PN): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINE (GCL):

DESIGN PARAMETERS (INPUT):

RESULTING DESIGN VALUES & DIMENSIONS:

FT

PIER THICKNESS

32.48 DEGREES 0 PSF 1000 PSF 688 PSF	FT (I	10) 80 FT PT)
	GTH (WH): 6 (WH = CSE-BE-TTH) SNGTH (L):	+ WH + TW): 8C CM + PN*PJ
DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LGTH (WH): 6 FT (WH = CSE-RE-TTH) FON LENGTH (L): 37 FT	(L = HW + PL + WH + TW) PDN WIDTH (B): 80 (R = CGW + WGW + PN*PT) SETSMIC PARAMETERS:
24 FT 518 FT 15,000 LBS	24 FT 530 FT 10,000 LBS	4 FT 3 FT 2 FT 3 FT
CHANNEL GATE: GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	WALKWAY GATES: GATE WIDTH - 2 GATES (WGW): SILL BLEV (WSE): GATE WEIGHT (WGWGT):	ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

SEISMIC PARAMETERS:

SEISMIC INERTIA DUE TO MASS = SUM(DL) * A ASSUMED CENTROID OF MASS = 0.4*(PE-BE)
SESIMIC FLUID FORCE (PER WESTERGAARD) = 0.67*51*A*(FE-BE)
FLUID FORCE RESULTANT ABOVE BASE = 0.4*(FE-BE)
OR 0.4*(TE-BE)

PROJECT: THAT FLOOD GATE CONTROL STRUCTURE

DESIGNED BY: WCS
CHUCKED BY:

DATE: 12/18/2004

OVERTURNING	MOMENT:																37,647,500	11,408,333	3,413,333		9,915,072	2,799	910	62 387 947	100190		ER - UPLIFT)	COHESION * BASE AREA NOTIVE RESISTING FORCES	SLIDING)					
RESISTING	MOMENT:	300,000	200,000	000,006,26	28,929,600	38,745,000	1,666,224	38,745,000	714,096	5,040,000	72,000	9,100,000	9,234,000	4,860,000	360,000	80,000				1.109.167				996 005 007	739,030,067		U* (WEIGHT CONC + GATES + WATER - UPLIFT)	SASE AREA	(FRICTION + COMESION) / (NET SLIDING)					
A CARC INC. WOR.	Mar 10 105:	20.00	20.00	20.50	20,50	20,50	5.51	20.50	5.51	35.00	1.00	35.00	27.00	27,00	4.00	1.00	18.50	24.67	5.33	7.9 6		9					- U* (WEIGHT CC	= COHESION * BASE AREA		í	CT.)			
	LATL FORCE:	4																	000 073		-302,500	CAP OTC	202		854,554		1,B	OLB	6,70 >1.0?	3.77 >1.0?	.69 (RELATIVE TO CL.)		PSF	•
	WEIGHT:	1 000 at	000	000 03 7	000,000,4	1,411,600 1,000,000	000,000,1	000,000	000,000,1	144 000	72 000	000,090	000,000	000	000	000	000,550 0	000,000,000	000 / Man-						8,998,700		5.728,143 IJB		n o	**	T. (1 + 6 * E	2699	2.597	4
STABILITY ANALYSIS:		CICH ALL MINISTER COMMISSION	CHANNEL GATE:	WALKWAY GATE:	CONCRETE FILITS	UPPER STRUCTURE:	CHANNEL BLOCK FINE	CHANNET, WEDGE P.DN.	WALKWAY BLOCK FUN:	WALKWAY WELCE FINE	HEEL SLAD	TOE STORE	FLUID ON AEEL:	FLUID ON CHANNEL SILL	FLUID ON WALKWAY STILE	FLUID ON DAS WEDGE:	FLUID ON TOE	UPLIFT FORCE (UI)	UPLIFT FORCE (UZ) :	FLUID HORIZ FORCE (H):	RESISTING FLUID FORCE:	SEISMIC INERTIA FORCE:	SEISMIC FLUID FORCE U/S: SEISMIC FLUID FORCE D/S:		SUBTOTAL AT BASE (V, MR, MO) =	STABILITY RESULTS:	= ((CIHd)N\$@*//) HOGON WOINDING	COINCION FORCE (CND*L*B)	NET SLIDING FORCE =	OVERTURNING RATIO (MR/MO)=	ECCENTRICTTY (E=L/2-(MR-MO)/V)) = $\frac{1}{1}$	MAX BEARING PRESS =	MIN BEARING PRESS =	VOLUME OF CONCRETE -

Section 8 Clear Fork Isolation Gate StructuresMass Concrete Foundation



Clear Fork Isolation Gate Structure Usual Load Condition - SPF

(File I1 SPF-NoDrain-Mass CFork.XLS)

- 1. Mass concrete foundation on rock.
- 2. Sliding Factor of Safety = 1.50
- 3. SPF level at El 552.5 on driving side.
- 4. Tailwater at El 520.0 on resisting side.
- 5. Friction angle at rock = 35 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL, STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CIIECKED BY: BAA

DATE: 12/18/2004

GATE STRUCTURE STABLLITY (W/ UPLIFT) SPF WATER ELEVATION (USUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

PACTOR OF SAFETY (FS): 1.5 ACTUAL SOIL FRICTION ANGLE (PHI): 35 DEGREES ACTUAL SOIL COHESION (CN): 0 RSF PLUID PRESS (EFP): 62.5 PCF CONC UNIT WGT (CUN): 150 PCF RESULFING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): 25.02 DEGREES DESIGN CORESION (CND): 0 PSF UPLIFT AT HEEL (UH): 4094 PSF UPLIFT AT TOR (UT): 2063 PSF	CONCRETE WEDGE HEIGHT & LGTH (WH): (WH = CSE-BE-TH) FOR LENGTH (L): 71 1°1'	(LL = RN + PL + MI + TW) $FINN WIDER (8): 58 FT$ $(B = CGW + WGW + EN*FF)$
GATE STRUCTURE: 552.5 FT FLOOD BLEV (FE): 552.5 FT TAILMATER ELFV (TE): 557 FT TOP OF PIER KLEV (FE): 557 FT FIN TAICKNESS (FT): 25 FT NO. OF CONC PIERS (FV): 7.33 FT UDPER STRUCTURE OUTLINE (USO): 98 FT UDSTREAM FACH TO GATE CTR LINE (GCL): 13 FT RU	CHANNEH GATE: 24 FT SILL FLEV (CSK): \$18 FT SILL FLEV (CSK): \$18 FT GATE WEIGHT (CGWGT): 15,000 LBS	WALKWAY GATE: 12 FT GATE WIDTH (WGW): 530 FT GATE WELGHT (WGWGT): 5,000 LBS	ADDL MEEL WIDTH (HW): 20 FT MEEL THICKNESS (HTH): 25 FT TOF THICKNESS (TTH): 25 FT

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PHSTR.DCS

DESIGNED BY: WCS
CHECKED BY: COM.

DATE: 12/18/2004

	WEIGHT:	LATE FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	LB	LB		MOMENT:	MOMENT:
CHANNEL GATE:	15,000		38.00	570,000	
WALKWAY GATE:	5,000		38.00	190,000	
CONCRETE PIERS:	3,217,500		38.50	123,873,750	
UPPER STRUCTURE:	1,058,400		38.50	40,748,400	
CHANNEL BLOCK FDN:	5,347,500		38.50	205,878,750	
CHANNEL WEDGE FDN:	1,159,200		23.11	26,788,284	
WALKWAY BLOCK FDN:	1,935,000		38.50	74,497,500	
WALKWAY WEDGE FUN:	302,400		23.11	6,988,248	
HEEL SLAB:	4,350,000		61.00	265,350,000	
TOE SLAB:	4,350,000		10.00	43,500,000	
FLUID ON HEEL.	2,936,250		61.00	179,111,250	
FLUID ON CHANNEL SILL:	342,000		45.00	15,390,000	
FLUID ON WALKWAY SILL:	90,000		45.00	4,050,000	
FLUID ON D/S WEDGE:	65,250		22.00	1,435,500	
FLUID ON TOE:	580,000		10.00	5,800,000	
UPLIFT FORCE (U1):	-8,493,375		35.50		301,514,812
UPLIFT FORCE (U2):	-4,182,344		47.33		197,964,271
FLUID MORIZ FORCE (H):		7,776,078	21.83		169,777,706
RESISTING FLUID FORCE:		-1,973,812	11.00	21,711,937	
SUBTOTAL AT BASE (V, MR, MO) =	13,077,781	5,802,266		1,015,883,619	669,256,789
STABILITY RESULTS:					
FRICTION FORCE (V*TAN(PHID))= COHESION FORCE (CND*L*B)= NET SLIDING FORCE = SLIDING RATIO + OVERTURNING RATIO (MR/MO)= ECCENTRICTTY (E=L/2-(MR-MO)/V)) = HEARING PRESSURE = V MAX BEARING PRESS = MIN HEARING PRESS =	6,104,774 LB 0 LB 0 LB 1,05 >1.07 1,52	03 03 ELATIVE TO	= U*(WEIGHT CONC + GATE COHESION * BASE AREA E DATVING FORCES MINUS (FRICTION + COHESION CL)	U* (WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA DRIVING PORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESION) / (NET SLIDING)	R - UPLIFT) EESISTING FORC

Clear Fork Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-Mass CFork.XLS)

- 1. Mass concrete foundation on rock.
- 2. Sliding Factor of Safety = 1.33
- 3. Maximum water level at El 556.5 on driving side.
- 4. Tailwater at El 520.0 on resisting side.
- 5. Friction angle at rock = 35 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED 1981 SOM

DATE: 12/20/04 DATE: 12/18/2004

GATE STRUGTURE STABILITY (W/ UPLIFT) MAXIMUM WAYER LEVEL TO OF LEVEE (UNUSUAL CONDITION)

DESIGN PARAMETERS (INPUT):

DIMENSIONS & WEIGHTS (INPUT):

1.33 35 DEGREES 0 PSF 62.5 PCF 150 PCF	27.77 DEGREES 0 PSF 4344 PSF 2063 PSF	6 FT - 71 FT - 71 FT - 78 FT - 58 FT - PN*PT)
FACTOR OF SAFETY (FS): ACTUAL SOIL PRICTION ANGLE (PHI): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HELGHT & LGTH (WH): (WH = CSE-BE-TTH) FDN LENGTH (L): (L = HW + PL, * WH + TW) FDN WIDTH (B): (B = CGW + WGW + PN*PT)
FT FT FT FT FT FT	FT FT 0 LBS	12 FT 530 FT 5,000 LBS 20 FT 25 FT 26 FT 25 FT
556.5 IVT 550 FT 557 FV 487 FV 25 FT 7.33 FY 98 IVT 13 FT	24 FT 518 FT 15.000 LBS	12 530 5,00(5,00(20 25 25 25 25 25
GATE STRUCTURE: FLOOD FLEW (FE): TALMATER FLEW (FE): TOP OF PIER ELEW (FE): PER BASE EL (FE): PIER ENOUTH (FL): NO. OF CONC PIERS (FT): NO. OF CONC PIERS (FU): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTY LINE (GCL):	CATE GATE GATE (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWCT):	MALKWAY GATE: GATE WIDTH (WGW): SILL ELEV (WSE): GATE WEIGHT (WGWGT): ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): TOR THICKNESS (TH):

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY:

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	000
DATE: 12/18/2004 DATE: 12 /20/04	
l I	TTY ANALYSIS:
4	Ž.

OVERTURNING MOMENT:	301,514,812 222,329,104 202,820,185	726,664,102	
RESISTING MOMENT: 570,000 123,873,750 40,748,400 205,878,284 74,497,500 6,988,248 265,350,000 43,500,000 43,500,000 43,500,000 196,801,250 1,435,500,000		21,711,937 1,033,573,619	
38.00 38.00 38.50 38.50 38.50 38.50 23.11 23.11 61.00 61.00 45.00	M M M M M M M M M M M M M M M M M M M		
LATI, FORCE:		8,754,828 -1,973,812 6,781,016	
	580,000 -8,493,375 -4,697,094	12,853,031	
CHANNEL GATE: CHANNEL GATE: CONCRETE PIERS: UPPER STRUCTURE: CHANNEL BLOCK FDN: WALKWAY BLOCK FDN: WALKWAY BLOCK FDN: WALKWAY BLOCK FDN: WALKWAY WEDGE FDN: HEEL SLAB: FLUID ON CHANNEL SILL: FLUID ON WALKWAY SILL: FLUID ON WALKWAY SILL:	FLUID ON TOE: UPLIFT FORCE (U1): UPLIFT FORCE (U2):	FLUID HORIZ FORCE (H): RESISTING FLUID FORCE: SUBTOTAL, AT BASE (V, MR, MO) =	

RESULTS:	
STABILITY	

U* (WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION) / (NET SLIDING) VE TO CI.)	
FRICTION FORCE (V*TAN(PHID)) = 6,766,759 LB	MIN BEARING PRESS = 50 FSF VOLUME OF CONCRETE = 5,363 CY

Clear Fork Isolation Gate Structure (with Drains) Unusual Load Condition - Max Water Level

(File I2 MAX-Drain-Mass CFork.XLS)

- 1. Mass concrete foundation on rock, with foundation drainage system.
- 2. Maximum water level at El 556.5 on driving side.
- 3. Tailwater at El 520.0 on resisting side.
- 4. Drains 33 percent effective, 10-ft downstream of headwall.

PROJECT: TRWD . FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: TSDA

DATE: 12/18/2004

141E:	CONDITION)
-	(UNUSUAL
Checked BI:	GATE STRUCTURE STABILITY (W/ UPLIFT) MAXIMUM WATER LEVEL TO TOP OF LEVER (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

: 1.33	ACTUAL SOIL FRICTION ANGLE (PHI): 35 DEGREES	ACTUAL SOIL COHESION (CN): 0 PSF	FLUID PRESS (EFP): 62.5 PCF	CONC UNIT WGT (CUW): 150 PCF	DRAIN EFFICIENCY (DE): 0.33	DRAIN DIMENSION FROM HEADWALL (DD): 10 FT			RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID): 27.77 DEGREES	DESIGN COHESION (CND): 0 PSF	UPLIFT AT HEEL (UH): 4344 PSF	UPLIFT AT TOE (UT): 2063 PSF	UPLIFT AT DRAIN (UD): 2998 PSF		CONCRETE WEDGE HEIGHT & LGTH (WH): 6 FT	(WH CSE-BE-ITH)	FDN LENGTH (L); 67 FT	(MI + PL + WH + TW)	TH SS : 58 PT	(B = CGW + WGW + PN*P)	
(FE): 556.5	(TE): 520	(PE): 557	FDN BASE EL (BE): 487 FT	PIER LENGTH (PL): 25 LT	PIER THICKNESS (PT): 7.33 FT	NO. OF CONC PIERS (PN): 3	UPPER STRUCTURE OUTLINE (USO): 98 FT	UPSTREAM FACE TO GATE CIR LINE (GCL): 13 PT	PES PES	CHANNEL GATE:	GATE WIDTH (CCW): 24 FT	SILL MEN (CSE): 518 FT	GAUF WEIGHT (CCWGT): 15,000 LBS		WAIRWAY GATE:	GATE WIDTH (WGW): 12 FT	SILI, ELEV (WSE): 530 FT	GATE WEIGHT (WGWGT): 5,000 LBS		ADDI, HREL WINTH (HW): 16 FT		ADDL TOK WIDTH (TW): 20 FT	TOE THICKNESS (TTH); 25 FT

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHANGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

СНЕСКЕВ ВУ: **ЗЗДД**.

12/18/2004	12/20/04
DATE:	DATE:

OVER-TURNING MOMENT: MOMENT: 30,397,033 244,117,867 59,198,816 202,820,185	637,078,715
RESISTING MODENT: 570,000 123,873,750 40,000 123,873,750 40,497,500 6,988,284 74,497,500 43,500,000 152,279,000 152,279,000 153,90,000 153,90,000 153,500,000 5,800,000	929,021,369
ARM TO TOE: 38.00 38.50 38.50 38.50 38.50 22.11 23.11 23.11 22.00 45.00 22.00 22.00 22.00 22.00 22.00	
LATE MORCE: LE S,754,828 -1,973,812	6,781,016
whie時間1 15,000 3,217,500 1,058,400 5,347,500 1,535,400 305,400 305,400 3,480,000 4,350,000 2,581,000 2,581,000 2,581,000 2,581,000 2,581,000 1,112,087 1,112,087 1,112,087	12,976,000
CHANNEL GATE: WALKWAY GATE: CONCRETE PIERES: UPPER STRUCTURE: CHANNEL MEDGE FDN: CHANNEL MEDGE FDN: WALKWAY BLOCK FDN: FLUID ON HERE: FLUID ON HERE: FLUID ON HERE: FLUID ON PAS BEDGE: FLUID ON PAS WEDGE: UPLIFT FORCE (U1): UPLIFT FORCE (U1): UPLIFT FORCE (U3): UPLIFT FORCE (U3): UPLIFT FORCE (U4): FLUID HONEE FORCE (U4):	SUBTOTAL AT BASE (V, MR, MO)

STABILITY RESULTS:

U* (WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION)/(NET SLIDING) TO CL)
FRICTION FORCE (V*TAN(PHID)) = 6,831,499 LB

Section 9 Clear Fork Isolation Gate Structures-RCC Foundation



Clear Fork Isolation Gate Structure Usual Load Condition - SPF

(File I1 SPF-NoDrain-RCC CFork.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at top of RCC.
- 3. Sliding Factor of Safety = 1.50
- 4. SPF level at El 552.5 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle on RCC = 45 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: BDA

DATE: 12/18/2004 DATE: 12/20/04

GATE STRUCTURE STABILITY (W/ UPLIFT) SPF WATER ELEVATION (USUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

	1.5	45 DEGREES	ASA 0	62.5 PCF								33,69 DEGREMS	O PSF	3031 PSF	1000 PSF			6 FT:	-BE-TTH)	FT 69	(ML + HA	58 FT	(,Ld * Nd -	
	FACTOR OF SAFHTY (FS):	ACTUAL SOIL FRICTION ANGLE (PHI):	ACTUAL SOIL COHESION (CN):	FLUID PRESS (EFP):	CONC UNIT WGT (CUW):					RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID):	DESIGN COHESION (CND):	UPLIFT AT HEEL (UH):	UPLIFT AT TOE (UT):			CONCRETE WEDGE HEIGHT & LGTH (WH):	(WH = CSE-BE-TIH)	FDN LENGTH (L):	(ML + HM + DI + MH + DI)	FIN WIDTH (B):	(B = CGW + WGW + PN*PT)	
	552.5 FT		557 FT		25 FT	7.33 FT	es	D4 86	13 FT			24 FT	518 FT	15,000 LBS			12 FT	530 FT	5,000 LBS		26 FT	ж Н.	12 FT	8 F.L
GATE STRUCTURE:	FLOOD ELEV (FE):	TAILWATER ELEV (TE):	TOP OF PIER ELEV (PE):	FDN BASE EL (BK):	PIER LENGTH (PL):	PIER THICKNESS (PT);	NO. OF CONC PIERS (PN):	UPPER STRUCTURE OUTLINE (USO):	UPSTREAM FACE TO GATE CIR LINE (GCL.):		CHANNEJ, GATE:	GATE WIDTH (CGW):	SILL ELEV (CSE):	GAT'E WEIGHT (CGWOT):		WALKWAY GATE:	GATE WIDTH (WGW):	SILL ELEV (WSE):	CATE WEIGHT (WGWGT):		ADDL HEEL WIDTH (NW):	HEEL THICKNESS (HTHI):	ADDL TOE WIDTH (TW):	TOE THICKNESS (TTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY:

DATE: 12/18/2004

OVERTURNING MOMENT:															138,069,000	186,968,437	68,925,826		393,963,263		U*(WEIGHT CONC + GATES + WATER UPLIFT) COHESION * BASE AREA BRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESION) / (NFT SLIDING)
RESISTING MOMENT:	450,000	150,000	98,133,750	32,281,200	73,657,500	34, 695, 000	1,815,048	101,337,600	5,011,200	213,759,000	12,654,000	3,330,000	913,500	2,088,000				2,474,667	590,698,149		U* (WEIGHT CONC + GATES + WATER U COHESION * BASE AREA DRIVING FORCES MINUS ACTIVE RESIST (FRICTION + COHESION) / (NFT SLIDING))
ARM TO TOE:	30.00	30.00	30.50	30.50	30.50	07.0%	15.28	76.00	00.9	56.00	37.00	37.00	14.00	6.00	34.50	46.00	16.17	5.33			= U* (WEIGHT CONC + GAT = COHESION * BASE AREA = BRIVING FORCES MINUS = (FRICTION + COHESION (CL)
LATL FORCE:																	4,263,453	-464,000	3,799,453		0,496 LB = 0 0 LB = 0 1.35 >1.0? = 0 1.50 >1.0? = 0 8.94 (RELATIVE TO CL) 3417 PSF 429 PSF
WEIGHT:	15,000	000,5	3,217,500	1,058,400	7,415,000	000,000	118,800	1,809,600	835,200	3,817,125	342,000	90,000	65,250	348,000	. 4,002,000	-4,064,531			7,695,744		5,130,496 LB 0 LB 0 LB 1.35 >1. 1.50 >1. 1.50 >1. 2.94 (RI 3417 PSI 429 PSI
STABILITY ANALYSIS:	CHANNEI, GATE:	WALKWAY GATE:	CONCRETE PIRKS:	UPPER STRUCTURE:	CHAINEL BLOCK FUN:	MALKEN PLOCE FINE	WALKWAY WEDGE FDN:	HEEL SLAB:	TOE SLAB:	FILUID ON MEEL,:	FLUID ON CHANNEL SILL:	FLUID ON WALKWAY SILL:	FLUID ON 13/S WEDGE:	FLUID ON TOE:	UPLIFT FORCE (U1):	UPLIFT FORCE (UZ):	FLUID HORIZ FORCE (II):	RESISTING FLUID FORCE:	SUBTOTAL AT BASE (V,MR,MO)	STABILITY RESULTS:	FRICTION FORCE (V*TAN(PHID)) = COMESION FORCE (CND*L*B) = NET SLIDING FORCE = OVERTURNING RATIO = OVERTURNING RATIO (MR/MO) = BECENTRICITY (E=L/2 (MR-MO)/V)) = MAX BEARING PRESSURE - MAX BEARING PRESS = MIN BEARING PRESS = VOLUME OF CONCRETE =

Clear Fork Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-RCC CFork.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at top of RCC.
- 3. Sliding Factor of Safety = 1.33
- 4. Maximum water level at El 556.5 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle on RCC = 45 degrees.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275-PRSTW.DCS

DESIGNED BY: CHECKED BY:

DATE: 12/10/04 DATE: 12/18/2004

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMIM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

36,94 DEGREES DECREES 0 PSF 3281 PSF 1000 PSF PSF PCF PCF FDW LEAGTH (L): 69 FT (L = MW + PL + WH + TW) FDW WIDTH (B): 58 FT (B - CGW + WGW + PW*PT) 0 62.5 150 1 9 (WII = CSE BE-TIM) 1.33 DELIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT): CONCRETE MEDGE HEIGHT & LGTH (WII): DESIGN FRICTION ANGLE (PHID): FACTOR OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (FIL): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS: 12 FT 530 FT 5,000 LBS 556.5 FT 520 FT 557 FT 504 FT 7.33 FT 7.33 FT 15,000 LBS 24 FT 518 FT GATE STRICTURE: FLOOD RLEV (FE): TAILWATER ELEV (TE): TOP OF PIER BLEV (FE): FUN BASK BL (BE): FIER LENOTH (FL): FIER THICKNESS (FT): GATE WIDTH (WGW): SILL KLEV (WSE): GATE WEIGHT (WGWGT): NO. OF CONC PIERS (PN): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CITE LINE (GCL): GATE WIDTH (CGW): SILL RLEV (CSE): CHANNEL, GATE: GAT'R WEIGHT (CGWGT): WALKWAY GATE:

FT 11.1 17.1

ADDL HEEL WIDTH (HW):
HEEL THICKNESS (HTH):
ADDL TOE WIDTH (TW):
TOE THICKNESS (TTH):

26

PROJECT: TRWD F1,00D GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PKSTR.DCS

DESIGNED BY: WCS
CHECKED BY: 130/

DATE: 12/18/2004

	WEIGHT:	LATL FORCE:	ARM TO TOK:	RESISTING	OVERPURNING
	17	LB		MOMENT:	MOMENT:
CHANNEL GATE:	15,000		30.00	450,000	
WALKWAY GATE:	5,000		30.00	150,000	
CONCRETE PIERS:	3,217,500		30.50	98,133,750	
UPPER STRUCTURE:	1,058,400		30.50	32,281,200	
CHANNEL BLOCK FDN:	2,415,000		30.50	73,657,500	
CHANNEL WEDGE FUN:	455,400		15.28	6,957,684	
WALKWAY BLOCK FON:	1,170,000		30.50	35,685,000	
WALKWAY WEDGE FUN:	118,800		15.28	1,815,048	
HEEL SLAB:	1,809,600		56.00	101,337,600	
TOE SLAB:	835,200		00.9	5,011,200	
FLUID ON HEEL;	4,194,125		26.00	234,871,000	
FLUID ON CHANNEL SILL:	342,000		37.00	12,654,000	
FLUID ON WALKWAY SILL:	90,000		37,00	3,330,000	
FLUID ON D/S WEDGE:	65,250		14.00	913,500	
FLUID ON TOE:	348,000		00.9	2,088,000	
UPLIFT FORCE (U1):	-4,002,000		34.50		138,069,000
UPLIFT FORCE (U2):	-4,564,781		46.00		209,979,937
FLUID HORIZ FORCE (H):		4,995,703	17.50		87.424.805
RESISTING FLUID MORCH:		-464,000	5,33	2,474,667	
SUBTROTAL AT BASE (V MR MO) =	7 599 404	4 5.31 703			

= U* (Welght Conc + Gates + Water · Uplift) COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES : (FRICTION + COHESION) / (NET SLIDING)	TO CL)
5,693,604 LB 0 LB 4,533,703 LB 1.26 >1.0? 1.40 >1.0?	11.21 (RELATIVE TO CL) /L(1+=6*K/L) 3737 PSF 47 PSF 2,736 CY
FRICTION FORCE (V*TAN(PHID)) = COHESION FORCE (CND*1,*B) = NET SLIDING FORCE SLIDING RATIO = OVERTUHNING RATIO (MR/MO)=	<pre>FCCENTRICITY (E=L/2 · (Mk MO) /V))= 11.21</pre>

STABILITY RESULTS:

Clear Fork Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-RCC-Base CFork.XLS)

- 1. Concrete structure on roller compacted concrete foundation to rock.
- 2. Stability at base of RCC (approximate).
- 3. Sliding Factor of Safety = 1.33
- 4. Maximum water level at El 556.5 on driving side.
- 5. Tailwater at El 520.0 on resisting side.
- 6. Friction angle at rock = 35 degrees.

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WES

DATE: 12/18/2004 DATE: 12/20/09

CATE STRUCTURE STABILLITY (W/ UPLIFT)
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNISUAL CONDETION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 35 DEGREES 0 PSF 62.5 PCF 150 PCF		27.77 DECREES 0 PSF 4344 PSF 2063 PSF	19 FT -BE-1718) 81.5 FT	. 1 (Train) 58 FT 19 × Ny
FACTOR OF SAFETY (FS): ACTUAL SOIL COHESION (CN): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW):	RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PRID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LGTH (WH): (WH = CSE-RE-1TM) FON LENGTH (L): 81.5	$\{L = MN + PL + MH + TW\}$ $MIDTR(R): 58$ $\{B = CGW + WCW + PV + PV$
520 FT 520 FT 557 FT 487 FT 25 FT	7.33 FT 3 98 FT 13 FT	24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS	28.66 上T 28.69 LT 11.55 FT 12 FT
GAUF SURUCTURE: FLOOD BLEV (FE): TATLWATER FLEV (TE): TOP OF PIER BLEV (PE): FIN BASE HL (BE): PIER LENGTH (PL):	PIER THICKNESS (PT): NO. OF CONC PIERS (PN): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTW LINE (GCL):	CHANNEL GATE: GATE WIDTH (CGW): HILL MLEV (CEW): GATE WEIGHT (GGWGT):	WALKWAY GATE: GATE WIDTH (WGW): SILL BLKV (WGE): GATE WEIGHT (WGMGT):	ALDE HEBE WEDYN (HW): HEBE YNTEKNESS (HTH): ABEN, TOE WEDYN (HW): TOE THICKNESS (HTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DGS

DESIGNED HY: WCS
CHECKED BY: 7504

DATE: 12/18/2004

STABILITY ANALYSIS:					
	WEIGHT:	LATE FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	LB	I,B		MOMENT:	MOMENT:
CHANNEL GATE:	15,000		42.50	637,500	
WALKWAY GATE:	5,000		42.50	212,500	
CONCRETE PIERS:	3,217,500		43.00	138,352,500	
UPPER STRUCTURE:	1,058,400		43.00	45,511,200	
CHAINNEL BLOCK F'DN:	5,347,500		43.00	229,942,500	
CHANNEL WEDGE FDN:	2,818,650		22.43	63,214,453	
WALKWAY BLOCK FON:	1,935,000		43.00	83,205,000	
WALKWAY WEDGE FDN:	735,300		22.43	16,490,727	
HEEL SLAB:	5,655,000		68.50	387,367,500	
TOE SLAB:	1,200,600		5.75	6,903,450	
FIUID ON HEEL:	4,194,125		68.50	287, 297, 562	
FLUID ON CHANNEL SILL:	342,000		49.50	16,929,000	
FLUID ON WALKWAY SILL:	90,000		49.50	4,455,000	
FLUID ON D/S WEDGE:	654,312		17.83	11,668,573	
FLUID ON TOE:	875,437		5.75	5,033,766	
UPLIFT FORCE (U1):	-9,749,437		40.75		397,289,578
UPLIFT FORCE (U2):	5,391,734		54.33		292,950,901
FLUID HORIN FORCE (H):		8,754,828	23.17		202,820,185
RESISTING FLUID FORCE:		1,973,812	11.00	21,711,937	
SUBTOTAL AT BASE (V, MK, MO)	13,002,653	6,781,016		1,318,933,169	893,060,664

STABILITY RESULTS:

= U* (WEIGHT CONC + GATES + WATER - UPLIFT) = COMESION * DASE AREA	= DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHECTON) / (NEW CITITION)		* TO CL)			
6,845,531 LB 0 LB	6,781,016 LB	1.48 >1.0?	8.00 (RELATIVE TO CL.) /L(1+-6*E/L)	4370 PSF	1131 PSF	5,424 CY
FRICTION FORCE (V*TAN(PHID)) = COHESION FORCE (CND*L*B) =	NET SLIDING FORCE =	OVERTURNING RATIO (MR/MO) =	BEARING PRESSURE = V/L(1+-6*E/L)	MAX BEAKING PRESS =	MIN BEARING PRESS =	VOLUME OF CONCRETE =

Section 10 Clear Fork Isolation Gate Structures-Pile Foundation



Clear Fork Isolation Gate Structure Usual Load Condition - SPF

(File I1 SPF-NoDrain-Pile CFork.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. SPF level at El 552.5 on driving side.
- 3. Tailwater at El 520.0 on resisting side.

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 13014

GATE STRUCTURE STABLLITY (W/ UPLIFT) SPF WATER ELEVATION (USUAL CONDITION)

DATE: 12/18/2004

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 35 DEGREES 0 PSF 62.5 PCF 150 PCF	27.77 DEGREES 0 PSF 2906 PSF 875 PSF	(EH): 6 FT = CSE-BE-TTH) (L): 48 FT PL + WH + TW) (B): 58 FT • WGW + PN*PT)
ACTUAL SOLL FRICTION ANGLE (PHI): ACTUAL SOLL COHESION (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LGTH (WH): 6 (WH = CSE-BE-TTH) FDN LENGTH (L): 48 (L = HW + PL + WH + TW) FDN WIDTH (B): 58 (B = CGW + WGW + PN*PT)
52.5 FT 520 PT 557 FT 506 FT 7.33 FT 98 FT 13 FT RESULTIN	24 FT 518 FT 15,000 LBS	12 FT CONC 5,000 LBS 0 FT 0 FT 17 FT 6 FT
GATE STRUCTURE: FLOOD BLEV (FE): TALLWATER BLEV (FE): TOP OF PIER BLEV (FF): FON BASE BL (BE): PIER LENGTH (PI): PIER THICKNESS (PT): NO. OF CONC PIERS (PN): UPPR STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINE (GCL):	CHANNEL GATE: GATE WIDTH (CGW): SILL ELFV (CSE): GATE WEIGHT (CGWGT):	GATE WIDTH (WGW): SILL RLEV (WSE): GATE WEIGHT (WGWC!): ADDL HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY:

DATE: 12/18/2004 DATE: 12/20/04

GOVERTURNING MOMENT:		306,650,165 Z09,689,711 U*INDIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESION) / (NET SLIDING)
RESISTING MOMENT:	525,000 114,221,250 37,573,200 73,485,000 7,578,684 38,340,000 1,977,048 0 7,542,900 14,364,000 3,780,000 1,239,750 4,190,500	306,650,165 Z09, U* [WEIGHT CONC + GATES + WATER - UF COHESION * BASE AREA DRIVING FORCES MINUS ACTIVE RESIST: [FRICTION + COHESION) / [NET SLIDING]
ARM TO TOE:	35.00 35.00 35.00 35.50 35.50 35.50 48.00 42.00 42.00 42.00 42.00 19.00 8.50 8.50 8.50 15.50	0* (WEIGHT CONC + GAT COHESION * BASE AREA = DRIVING FORCES MINUS = (FRICTION + COHESION O CL)
LATL FORCE:	3,919,078	9,850 3,563,828 4,838 LB C C C C C C C C C C C C C C C C C C
WEIGHT:	15.0 1,058, 1,058, 1,080,	4,528 2,38 3,56 V/L(1+-6
STABILITY ANALYSIS:	CHANNEL GATE: WALKWAY GATE: CONCRETE PIERS: UPPER STRUCTURE: CHANNEL BLOCK FDN: CHANNEL BLOCK FDN: WALKWAY BLOCK FDN: WALKWAY WEDGE FDN: HEEL SLAB: FLUID ON CHANNEL SILL: FLUID ON WALKWAY SILL: FLUID ON WALKWAY SILL: FLUID ON DAS WEDGE: UPLIFT FORCE (UI): UPLIFT FORCE (UI): RESISTING FLUID FORCE: RESISTING FLUID FORCE:	SCHOOTAL AT BASE (V, MR, MO) STABILITY RESULTS: FRICTION FORCE (V*TAN(PHID)) = 2 COHESION FORCE (CND*L*B) = 3 SLIDING FORCE = 3 SLIDING FORCE = 3 SLIDING RATIO = 6 OVERTURING RATIO (MR/MO) = 6 ECCENTRICITY (E=1,2-(MR-MO)/V)) = 6 EARING PRESS = MIN BEARING PRESS = VL(1)

Clear Fork Isolation Gate Structure Unusual Load Condition - Max Water Level

(File I2 MAX-NoDrain-Pile CFork.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Maximum water level at El 556.5 on driving side.
- 3. Tailwater at El 520.0 on resisting side.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY: 3304

DATE: 12/18/2004

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSTAL CONDITION)

DESIGN PARAMETERS (INPUT):

DIMENSIONS & WEIGHTS (INPUT):

PACTOR OF SAFETY (FS): 1.33 ACTUAL SOIL FRICTION ANGLE (PHI): 35 DECREES ACTUAL SOIL COHESION (CN): 0 PSF FLUID PRESS (EFP): 62.5 PCF CONC UNIT WGT (CUW): 150 PCF	DESIGN FRICTION ANGLE (PHID): 27.77 DEGREES DESIGN COHESION (CND): 0 PSF UPLIFT AT HEEL (UH): 3156 PSF UPLIFT AT TOE (UT): 875 PSF	CONCRETE WEDGE HEIGHT & LGTH (WH): (WH = CSE-BE-TTH) FIN LENGTH (L): AB FF	(L = HW + PL + WH + TW) $FDN WIDTH (B):$
556.5 FT 520 FT 557 FT 506 FT 25 FT 7.33 FT 98 FT 13 FT	24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS	0 FT 0 FT 17 FT 6 FT
GATE STRUCTURE: PLOOD ELEV (FE): TAJIMATER ELEV (TE): TOP OF PIER FLEV (PE): FON BASE EL (BE): PIER LENOTH (PL): PIER THICKNESS (FT): NO. OF GONC PIERS (PV): UPPER STRUCTURE OUTLINE (USO): UPPER STRUCTURE OUTLINE (USO):	CHANNEL GATE: GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	WALKWAY GAUE: GATE WINTH (WGW): SILL ELEV (WSE): GAYE WEIGHT (WGWGT):	ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (T'H):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

CHECKED BY: 13.04 DESIGNED BY: WCS

DATE: 12/18/2004	NALYSIS:
1304 1304	STABILITY ANALYSIS

CICIONE VINCENTO					
	WEIGHT:	LATL FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	1,8	LB		MOMENT:	MOMENT:
CHANNEL GATE:	15,000		35.00	525,000	
WALKWAY GATE:	5,000		35.00	175,000	
CONCRETE PIERS:	3,217,500		35.50	114,221,250	
UPPER STRUCTURE:	1,058,400		35.50	37,573,200	
CHANNEL BLOCK FUN:	2,070,000		35.50	73,485,000	
CHANNEI, WEDGE FUN:	372,600		20.34	7,578,684	
WALKWAY BLOCK FDN:	1,080,000		35.50	38,340,000	
WALKWAY WEDGE FDN:	97,200		20.34	1,977,048	
HEEL SLAB:	0		48.00	0	
TOE SLAB:	887,400		8.50	7,542,900	
FLUID ON HEEL:	C		48.00	0	
FIGURE ON CHANNEL SILL:	342,000		42.00	14,364,000	
FLUID ON WALKWAY SILL:	000'06		42.00	3,780,000	
FLUID ON D/S WEDGE:	65,250		19.00	1,239,750	
FLUID ON TOE:	493,000		8.50	4,190,500	
UPLIFT FORCE (UI):	-2,436,000		24.00		58.464,000
UPLIM" FORCE (UZ):	-3,175,500		32.00		101,616,000
FINID MORIZ FORCE (H):		4,622,328	16.83		77, 809, 190
RESISTING FLUID FORCE:		-355,250	4.67	1,657,833	
SITEMONIAL ATT BACE (V NB NOV.)	0 10 1	3			
SUBJOINT AL BASE (V, MK, BO) =	4, Lal, 800	4,257,078		306,650,165	237,889,190

= U*(WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * HASE AREA	= DRIVING FORCES MINUS ACTIVE RESISTING FORCES	= (FRICTION + COHESION) / (NET SLIDING)		TO CI,)				
2,201,626 LB 0 LB	4	0.52 >1.0?		7.56 (RELATIVE TO CL.)	V/L(1+=6*E/L)	2921 PSF	484 E8	2,169 CY
FRICTION FORCE (V*"AN(PHID)) COHESION FORCE (CND-L-E)=	NET SLIDING FORCE =	SLIDING RATIO =	OVERTURNING RATIO (MR/MO)	ECCENTRICITY (F=L/2-(MR-MO)/V))=	BEARING PRESSURE = V/L(1+=6*H/L)	MAX BEARING PRESS =	MIN BEARING PRESS	VOLUME OF CONCRETE =

STABILITY RESULTS:

Clear Fork Isolation Gate Structure Extreme Load Condition - Seismic

(File I3 SEISMIC-NoDrain-Pile CFork.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Normal pool level at El 525.0 on driving side.
- 3. Tailwater at El 520.0 on resisting side.
- 4. Horizontal ground acceleration = 0.05 g.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 504

DATE: 12/18/2004

DATE: (2 20 00

REXTREME CONDITION) GATE STRUCTURE STABILITY (W/ UPLIFT) NORMAL POOL ELEVATION WITH SEISMIC (

		1.1 35 DEGREES 0 PSF 62.5 PCF 150 PCF 0.05 g	32.48 DEGREES 0 PSF 1188 PSF 875 PSF	(SE-BE TTH) (SE-BE TTH) (SE-BE TTH)	58 FT + PN*PT)	
	DESIGN PARAMETERS (INPUT):	PACTOR OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (PHI): ACTUAL SOIL COHESTON (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): SELSMIC COEFFICIENT (A): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND): UPLIFT AT HEEL (UH): UPLIFT AT TOE (UT):	CONCRETE WEDGE HEIGHT & LGTH (WH): (WH (SE-BE TTH) FIN LENGTH (L): (YA - NA - NA - WH + TW)	FUN WIDTH (B): 58 (B. CGW + MGM + PN*PP)	SEISMIC PARAMETERS:
E CONDITION)		525 525 525 525 525 525 53 53 53 53 53 53 53 53 53 53 53 53 53	24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS	0 MM 0 MM 17 FT 6 FT	
IORMAI, POOL ELFVATION WITH SEISMIC (EXTREME CONDITION)	DIMENSIONS & WEIGHTS (INPUT):	GATE STRUCTURE: PLOOD ELEV (FE): TOP OF PIER RLEV (FE): FON BASE EL (BE): FON BASE EL (BE): PIER LENGTH (PL): PIER THICKNESS (FT): NO. OF CONC PIERS (FV): UPPER STRUCTURE OUTLINE (USO): UPSENBEAM FACE TO GAME CTR LINE (GCL):	CHANNEL GATE: (GATE WIDTH (CGW): STIL ELEV (CGR): (ATE WEIGHT (CGWUX):	WALKWAY GATE: GATE WIDTH (WGW): SILL ELEV (WGE): GATE WEICHT (WGWGE):	AUDL REEL WIDTH (HW): HEREL WITCHNESS (HTH): ADDL TVE WIDTH (TW): TOF THICKNESS (TTH):	

SEISMIC PARAMETERS:

SEISMIC INERTIA DUE TO MASS = SUM(DL) * A
ASSUMED CENTROID OF MASS : 0.4*(PE-BE)
SESIMIC FLUID FORCE (PER MESTERGAARD) = 0.67*51*A*(FE-BE)^2
FLUID FORCE RESULTANT ABOVE BASE = 0.4*(FE-BE)
OR 0.4*(FE-BE)

CHARGE NO.: 2521-42275-PRSTR, DCS

DESIGNED BY: WCS
CHECKED BY:

DATE: 12/18/2004

DATE: 12/20/04

PATRICE ANTALVETO					
STABLLIT ANALISTS:	MEIGHT:	LATL FORCE:	ARM TO TOE:	RESISTING	OVERTURNING
	LB	LB		MOMENT:	MOMENT:
CHANNET. CATE.	15.000		35.00	525,000	
THE HEAVING	000		35.00	175,000	
WALKWAY GATE:	000 . 000		25 50	134,221,250	
CONCRETE PIERS:	3,217,500		200	27 572 000	
UPPER STRUCTURE:	1,058,400		35.50	0000	
CHANNEL BLOCK FUN:	2,070,000		35.50	73,485,000	
- NOTE SOCIETY NAMED OF	372,600		20.34	7,578,684	
	1 080,000		35.50	38,340,000	
	000 25		20.34	1,977,048	
WALKWAI WELCE LUN			48.00	0	
TASTO GOOD	887 400		8.50	7,542,900	
STILL ON HERE.	C		48.00	0	
TILE LEMNING WO WELL	342.000		42.00	14,364,000	
PLOID ON CHONNESS CLASS	90,000		42.00	3,780,000	
COUNTY OF MANAGEMENT OF THE PARTY OF THE PAR	65,250		19.00	1,239,750	
TOPE NO CHILD	493 000		8.50	4,190,500	
TOT NO OTOTA	000		24 00		58,464,000
UPLIFT FORCE (U.)	000,000,000		32.00		13,920,000
UPLIFT FUNCE (UZ)	-435,000		33		4.143.979
FLUID NORIZ FORCE (H):		210,800		1 650 933	
RESISTING FLUID FORCE:		-355,250	10.0	0001001	250 000
SEISMIC INERTIA FORCE:		395,785	20		F 0 0 0
SEISMIC FLUID FORCE U/S:		617	7.6		100.
SEISMIC FLUID FORCE D/S:		335	9.6		1,875
(OM cim 11) do so me trenomeres	6, 422, 350	695.799		306,650,165	84,608,556
CHICALLY SOUR TO THE					
STABILITY RESULTS:					
FEBTONION BORD (VITAN (PHID))	4,406,438 LIB	1,13	= U* (WEIGHT CON	U* (WEIGHT CONC + GATES + WATER - UPLIFT)	R - UPLIFT)
COMESTON MORCE (CND*L*B)=	0	0 1.3	COMESION . BASE AREA	SE AREA	
NET SLIDING FORCE =	85,799 LB	LB	DRIVING FORCE	DRIVING FORCES MINUS ACTIVE RESISTING FORCES	ESISTING FORCES
SLIDING RATIO	6.33	6.33 >1.02	= (FRICTION + C	(FRICTION + COMESION) / (NET SLIDING)	(DNIG)
OVERTURNING RATIO (MR/MO)=	W. 62	3.62 >1.0?			
ECCENTRICITY (E=L/2-(MR-MO)/V))=	-8.08	-8.08 (RELATIVE TO CL)	(F)		
BEARING PRESSURE = $V/L(1+-6*E/L)$	V/L(1+-6*E/L)				
MAX BEARING PRESS =	-2-				
MIN BEARING PRESS =	1000	PSST			
VOLUME OF CONCRETE =	Z,169 CY	77			

Section 11 Stability Analyses for Abutment Structures



TRWD Abutment Structures Unusual Load Condition - Max Water Level

(Files: MAX-Abut-E TRWD.XLS & MAX-Abut-W TRWD.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Maximum water level at El 544.0 on driving side.
- 3. Tailwater below base on resisting side.
- 4. Balanced soil pressures neglected for preliminary design.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR. DUS

DESIGNED BY: WGS

CHECKED BY: 75024

DATE: 12/18/2004

DATH: 12/20/04

GATE ABUTMENT STRUCTURE STABILITY MAXIMUM WATER LEVEL TO TOP OF LEVER (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 28 DEGREES 0 PSF 62.5 PCF 150 PCF 110 PCF	ARCTAN (TAN (PHI)): 21.79 DECREES ARCTAN (TAN (PHI)/FS)) IRBION (CNI): 0 PSI: (CND CN / FS) AT HEEL (UH): 1125 PSI: (UN = (FE-BE) * EFP) AT TOR (UT): 0 PSI: (UT = (TE-RE) * EFP)
(FS): PIL1): (CN): (EFP): (CUW): (CSW):	H110): TAN (P CND): ND (UH): (FE-BE (UT): (TE-BE
PACTOR OF SAPETY (FS): ACTUAL SOIL FRICTION ANGLE (PIL): ACTUAL SOIL COHESION (CN): FLUID PRESS (EFP): CONTAINED SOIL WGT (CUW): CONTAINED SOIL WGT (CSW): RESULFING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): 21.79 (PHID = ARCTAN(TAN(PHI)/FS)) DESIGN COHESION (CND): 0 (UPLIFT AT HEEL (UH): 1125 (UPLIFT AT TOK (UT): 0 (UT):
ACTUAL	Δ
PT FT FT FT FT FT FT	1.4 1.4 1.4 1.4 1.4 1.4
	m 2009
GAUE AHUTMENT STRUCTURE: FLOOD BLKV (FE): TALLWATER RIEV (TE): TOP OF DECK RLEV (TDE): DECK WIDTH (DW): HEADWALL, THICKNESE (HWT): NO, OF BUTTRESS WALLS (NE): HOTTON SIAB THICKNESS (ST):	STRUCTURE LENGTH (B): ADDL HRRL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOR WIDTH (TW): TOR THICKNESS (T'H):

FDN LENGTH (L): 25 FT (L HW + DW + TW)

PROJECT: THWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTM.DCS

DESIGNED BY: WCS

CHECKED BY: 7504

DATE: 12/18/2004

RESISTING OVERTURNING MOMENT:	8,967,600 7,453,125 0 3,726,563 7,453,125 0	0 12,421,875 3,219,750	27,600,413 15,641,625
ARM TO TOE:	24.00 12.50 0.00 12.50 12.50 25.00 25.00	0.00 12.50 16.67 6.00 2.00	
WEIGHT: LATE FORCE: LB		536,625	536,625
WEIGHT:	373,650 596,250 298,125 596,250	0 0 0 .745,313	1,118,963
STABILITY ANLYSIS:	HEADWALL: BUTTRESS WALLS(1): BUTTRESS WALLS(2): TOP SLAB: BOTTOM SLAB: HEEI, SLAB: TOE SLAB:	FLUID ON HERL: FLUID ON TOE: UPLIFT FORCE (U1): UPLIFT FORCE (U2): FLUID HORIZ FORCE (H): RESISTING FLUID FORCE:	(OM div ii) diget me semonton

STABILITY RESULTS:

= U*(WEIGHT CONC + GATES + WATER - UPLIET) COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESION)/(NET SLIDING)	VE TO CL.)
4 1,	1.76 >1.07 1.81 (RELATIVE TO CL.) V/I.(1+-6*E/I.) 1212 PSF 477 PSF 460 CY
FRICTION FORCE (V*TAN(PHID)) = COMESION FORCE (CND*L*B) = NET SLIDING FORCE = SLIDING RATIO =	OVERTURNING RATIO (MR/MO) = 1.76 HCCENTRICITY (E=L/2-(MR-MO)/V)) = 1.81 BEARING PRESSURE = V/I,(1+-6*E/I,) MAX BEARING PRESS = 1212 MIN BEARING PRESS = 477 VOLUME OF CONCRETE = 460

PROJECT: TRWD - FLOOD GAVE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 7504

DATE: 12/18/2004 DATE: 12/20/04

GATE ABUTMENT STRUCTURE STABILITY
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

	POF POF	21.79 DEGREES	7S)) PSF PSF 1125 PSF PSF PSF PSF PSF PSF PSF PSF PSF PSF PSF PSF PSF
1.33	62.5 150 110		H H
FACTOR OF SAFETY (FS): AL SOLL FRICTION ANGLE (PHI): ACTUAL: SOLL COHESION (CN):	CONTAINED SOIL WGT (CSW):	RESULTING DESIGN VALUES & DIMENSIONS: DESIGN FRICTION ANGLE (PHID):	PHID = ARCTAN(TAN(PHI)/FS) DESIGN COHESION (CND): 0 OPLIFT AT HELL (UH): 1125 UPLIFT AT TOE (UT): 0 UPLI
ACTUAL		ESULTING	
FT	FT FT FT FT FT	FF	FT C C C FT T T T T T T T T T T T T T T
544	22.2 22.2 22.2 2.0 2.0 2.0 2.0 3.0 4.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5	3 26	
GATE ABUTMENT STRUCTURE: FLOOD ELEV (FE): TAILMATER ELEV (TE):	TOP OF DECK ELEV (TDE): PDN BASE EL (BE): DECK WIDTH (DW): IIFADWALL THICKNESS (HWT): NO. OF BUTTRESS WALLS (WT): NO. OF BUTTRESS WALLS (NE):	HOP SLAB THICKNESS (EST): BOTTOM SLAB THICKNESS (BST): STRUCTURE LENGTH (B):	ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

FIN LENGTH (L): 25 FT (1, = HW + DW + TW)

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 7504

DATE: 12 (20/04) DATE: 12/18/2004

OVERTURNING MOMENT:	0 6,093,750 1,579,500	7,673,250
RESISTING MOMENT:	4,197,600 4,968,750 1,828,125 3,656,250 0	14,650,725
ARM TO TOE:	24.00 12.50 0.00 12.50 12.50 25.00 0.00 12.50 16.67 6.00	
LATL FORCE:	263,250	263,250
WEIGHT:	174,900 397,500 146,250 292,500 0 0 0 0 0 0 -365,625	645,525
STABILITY ANALYSIS:	HEADWALL: BUTTRESS WALLS(2): BUTTRESS WALLS(2): TOP SLAB: BOTTON SLAB: TOE SLAB: FLUID ON HEEL: TOE: UPLIFT FORCE (U1): FLUID HORIZ FORCE (H): RESISTING FLUID FORCE:	SUBTOTAL AT BASE (V, MR, MO) =

STABILITY RESULTS:

U* (MEIGHT CONC + GATES + WATER - UPLIFT) = COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION) / (NET SLIDING) 5 TO CL)	
258,069 LB U*(0 LB = COH 263,250 LB = DRI 0.98 >1.0? = (FF 1.91 >1.0? 1.69 (HELATIVE TO CL)	
FRICTION FORCE (CND*1,*B) COHESION FORCE (CND*1,*B) OF SLIDING FORCE 263,2550 SLIDING RATIO 0.98 OVERTURNING RATIO (MR/MO) = 1.91 ECCHNITICITY (F=L/2-(MR-MO)/V))=	The state of the s

(F=L/2=(NR-NO)/V)]=
BEARING PRESSURE = V/L(1+-6*E/L)
AX BERRING PRESS = 1396 PSF
MIN HEARING PRESS = 590 PSF
VOLUME OF CONCRETE = 250 CY

Trinity Point Abutment Structures Unusual Load Condition - Max Water Level

(File: MAX-Abut-E & W TPoint.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Maximum water level at El 549.5 on driving side.
- 3. Tailwater below base on resisting side.
- 4. Balanced soil pressures neglected for preliminary design.

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 7304

DATE: 12/18/2004 DATE: (2/20/04)

CHECKED BY:

GATH ABUTMENT STRUCTURE STABILITY

MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

FLOOD ELEV (FE):	549.5 F	.1.	FACTOR OF SAFETY (FS):	1.33	
TAILWATER ELEV (TE):	520 F	FT	ACTUAL SOIL FRICTION ANGLE (PHI):	28 D	DEGREES
TOP OF DECK ELEV (TDE):	557 F		ACTUAL SOIL COHESION (CN):	0	PSF
FDN BASE EL (BE):	1,26 F	ŀΤ	FLUID PRESS (EFP):	62.5 p	PCF
DECK WIDTH (DW):	25 F	F'I'	CONC UNIT WGT (CUW):	150 P	CE
HEADWALL THICKNESS (HWT):	2 F	FT	CONTAINED SOIL WGT (CSW):	110 P	CF
BUTTRESS WALL THICKNESS (BWT):	2 1	FT			
NO. OF BUTTRESS WALLS (NB):	2				
TOP SLAB THICKNESS (TST):	1.5	FT			
BOTTOM SLAB THICKNESS (BST):	2		RESULTING DESIGN VALUES & DIMENSIONS:		
STRUCTURE LENGTH (B):	22 F	L.A.			
			DESIGN FRICTION ANGLE (PHID):	21.79 DEGREES	EGREES
ADDL HEEL WIDTH (HW):	0	Ţ	(PHID = ARCTAN(TAN(PHI)/FS)	((SA	
HEEL THICKNESS (HTH):	0	FT	DESIGN COHESION (CND):	O PSF	SF
ADDL TOE WIDTH (TW):	9	F.T.	(CND = CN / FS)	FS	
TOE THICKNESS (T'TH):	m	T	UPLIFT AT HEEL (UH):	1469 PSF	SF
			(UM = (FE-BE) *	EFP)	
			UPLIFT AT TOE (UT):	0 PSF	SF
			COST - VICE WAY - BIT !	1 2000	

FDN LENGTH (L): 31 FT (L = HW + DW + TW)

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS
CHECKED BY:

DATE: 12/18/2004 DATE: 12/20/64

OVERTURNING MOMENT:	0 10,350,771 2,974,096	13,324,867
RESISTING MOMENT:	4,293,000 7,353,750 176,488 2,289,375 4,578,750 178,200 0	18,869,563
ARM TO TOE:	30.00 18.50 4.00 18.50 18.50 31.00 31.00 31.00 15.50 20.67 7.83	
LATE FORCE: LB	379,672	379,672
WEIGHT: LB	143,100 397,500 44,100 123,750 247,500 59,400	514,506
STABILITY ANALYSIS:	HEADWALL: BUTTHESS WALLS(1): BUTTHESS WALLS(2): TOP SLAB: BOTTOM SLAB: HEEL SLAB: TOE SLAB: FLUID ON TOE: PLUID ON TOE: UPLIFT FORCE (U1): FLUID HORIZ FORCE (U2): RESISTING FLUID FORCE:	SUBTOTAL AT BASE (V, MR, MO) =

STABILITY RESULTS:

= U* (WEIGHT CONC + GATES + WATER - UPLIFT) = COHESION * BASE AREA : DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION) / (NET SLIDING)
205,690 LB = CC 0 LB = CC 3/9,672 LB : DR 0.54 >1.0? = (F 1.42 >1.0? = (L) 4.72 (RELATIVE TO CL) V/L(1+-6*E/L) 1444 PSF 65 PSF 251 CY
FRICTION FORCE (V*!AN(PHID)) 205,690 COHESION FORCE (CND*L*H) = 0.54 NET SLIDING FORCE 3/19,672 SLIDING RATIO = 0.54 OVENTURAING RATIO (MR/MO) 1.42 ECCENTHICITY (E=L/2 (MR-MO)/V) = 4.72 MAX BEARING PRESS = 1444 MIN BEARING PRESS = 65 VOLUME OF CONCRETE # 251

Clear Fork Abutment Structures Unusual Load Condition - Max Water Level

(Files: MAX-Abut-E CFork.XLS & MAX-Abut-W CFork.XLS)

- 1. Concrete structure on battered steel H-piles to rock.
- 2. Maximum water level at El 556.5 on driving side.
- 3. Tailwater below base on resisting side.
- 4. Balanced soil pressures neglected for preliminary design.

PROJECT: TRWD - PLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 7504

DATE: 12/18/2004 DATE: 12/20/04

DATE: COL

GATE ABUTMENT STRUCTURE STABLLITY
MAXIMUM WATER LEVEE TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

DECKEES PSF PCF PCF		21.79 DEGREES FS) 0 PSF 1906 PSF EFP) PSF
1.33 28 28 62.5 150		21.79 ()/FS)) 0 1906 * EFP)
FACTOR OF SAFETY (FS): ACTUAL SOIL COHESION (CN): ACTUAL SOIL COHESION (CN): CONC UNIT WGT (CUW): CONTAINED SOIL WGT (CSW):	RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): 21.79 (PHID = ARCTAN(TAN(PHI)/FS)) DESIGN COHESION (CND): 0 (CND = CN / FS) UPLIFT AT HEEL (UH): 1906 (UH = (FK BE) * EFP) UPLIFT AT TOE (UT): 0
	FF	FT
556.5 520 520 520 2 2 2 2 4	1.5	12 00 00 00 00 00 00 00 00 00 00 00 00 00
GATE ABUTMENT STRUCTURE: FLOOD ELEV (FE): TOP OF DECK ELEV (TE): FON BASE EL (BE): DECK WIDTH (DW): HEADWALL THICKNESS (HWT): BUTTRESS WALL THICKNESS (BWT): NO. OF BUTTRESS WALLS (NB):	TOP SLAB THICKNESS (TST): ROTTOM SLAB THICKNESS (BST):	STRUCTURE LENGTH (B): ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

FDN 1.ENGTH (1.): 47 FT (L. HW + DW + TW)

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2531-43275=PRSTR.DCS

CHECKED BY: 750A DESIGNED BY: WGS

DATE: 12/18/2004 DATE: 2/2/2/

OVERTURNING MOMENT:	0	112,290,833 23,643,854	135,934,688
RESISTING MOMENT:	16,299,600 23,793,750 1,290,645 10,125,000 40,500,000 3,600,000 3,600,000 60,270,000	0	191,302,995
ARM TO TOF:	34.00 22.50 6.67 22.50 22.50 41.00 5.00 5.00 5.00	31.33 10.17 -2.00	
LATL FORCE: LB		2,325,625	2,325,625
WEIGHT: LB	479,400 1,057,500 193,500 450,000 1,800,000 864,000 1,470,000	3,583,750	3,450,650
STABILITY AMALYSIS:	HEADWALL: BUTTRESS WALLS (1): BUTTRESS WALLS (2): TOP SLAB: HENL SLAB: FLUID ON TREL! FLUID ON TREL!	UPLIFT FORCE (UI): UPLIFT FORCE (UI): FAUID HORIZ FORCE (H): RESIETING FILUID FORCE:	SUBTOTAL AT BASE (V, MR, MO)

STABILITY RESULTS:

= U*(WEIGHT CONC + GATES + WATER - DPLIET) COMESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES . (FRICTION + COHESION)/(NET SLIDING) //E TO CL.)	
1,379,506 LB	
FRICTION FORCE (V*TAN(PHID)) 1,379,506 1 COHESION FORCE (CND*L*E) = 0,325,625 8 LIDING FORCE (CND*L*E) = 0,595 625 1 1,312 NG FATIO = 0.59	

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/18/2004 DA'TE: 12/20/04

GATE ARUTMENT STRUCTURE STABILITY
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

GATE ABUTMENT STRUCTURE: FLOOD ELEV (FE): TAILWATER ELEV (TR): TOP OF DECK ELEV (TDE): FDN BASE EL (RE): DECK WIDTH (DW):

DEGREES PCF PCF PCF 1.33 28 0 62.5 150 110 FACTOR OF SAFETY (FS): ACTUAL SOIL FRICTION ANGLE (PHI): ACTUAL SOIL COHESION (CN): FLUID PRESS (FFP): CONC UNIT WOT (CUW): FT FT FT FT FT 556.5 520 557 526 25 23 3 1.5 23

DESIGN PARAMETERS (INPUT):

RESULTING DESIGN VALUES & DIMENSIONS:

F.1.

HOTTOM SLAB THICKNESS (TST): HOTTOM SLAB THICKNESS (BST): STRUCTURE LENGTH (B):

HEADWALL THICKNESS (HWT): BUTTHESS WALL THICKNESS (BWT): NO. OF BUTTRESS WALLS (NR):

DESIGN FRICTION ANGLE (PHID): 21.79 DEGREES (PHID = ARCTAN (TAN (PHI) / FS)) (CND : 0 PSF (CND = CN / FS) (UN = (CND): 1906 PSF (UN = (FE-BE) * FFP) (UN = (FE-BE) * FFP) (UT = (TE-BE) * FFP)
FT FT FT FT

12 6 8

ADDL HEEL WIDTH (HW):
HEEL THICKNESS (HTH):
ADDL TOE WIDTH (TW):
TOE THICKNESS (TTH):

ī FIN LENGTH (L): #5 (L = 1TM + DM + TW)

PROJECT: TRWD - FLOOD GATH CONFROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/18/2004

	OVERTURNING MOMENT:	0 29,594,531 6,797,608	36,392,139
	RESISTING MOMENT:	3,835,200 10,839,375 415,006 2,652,188 10,608,750 9,687,600 662,400 16,482,375	55,180,894
	ARM TO TOE:	32.00 20.50 5.34 20.50 20.50 39.00 4.00 22.50 22.50 10.17 2.00	
DATE: 12/20/04	LATE FORCE:	668,617	668,617
DATE: [3	WEIGHT: LB	119,850 528,750 77,400 129,375 517,500 248,400 165,600 122,625	1,223,016
Y: BDA	STABILITY ANALYSIS:	HEADWALL: BUTTRESS WALLS(1): BUTTRESS WALLS(2): TOP SLAB: BOTTOM SLAB: HEEL SLAB: TOE SLAB: FLUID ON HEEL: FLUID ON TOE: UPLIFT FORCE (U1): UPLIFT FORCE (U1): FLUID HORIZ FORCE (H): RESISTING FLUID FORCE:	JETOTAL AT BASE (V, MR, MO)

STABILITY RESULTS:

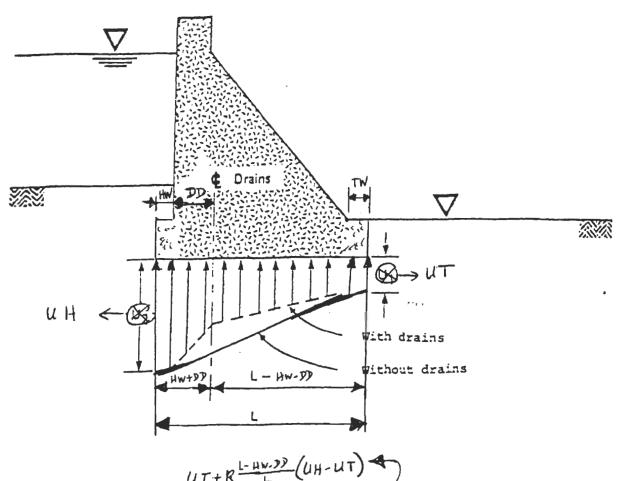
SUBTOTAL AT BASE (V,MR,MO)

The second secon	8,939 LB = U*(WEIGHT CONC + GATES + WATER - UPLIFT) 0 LB = COHESION * BASE AREA 8,617 LB : DRIVING FORCES MINUS ACTIVE RESISTING FORCES 0.73 >1.0?
	488,939 I.B 0 LB 0 CB (617 I.B 0.73 >1.0? 1.52 >1.0? 7.14 (RELAT) (1+-6*E/L) 57 PSF 57 PSF 441 CY
	FRICTION FORCE (V*TAN(PHID)) = 488,939 I COHESION FORCE (CND*1.^kB) : 668,617 I NET SLIDING FORCE = 0.73 SLIDING RATIO = 0.73 OVERTURING RATIO (MR/MO) ECCENTRICITY (E=L/2-(MR-MO)/V)) = 1.52 BEARING PRESSURE = V/I.(1+-6*E/L) MAX BEARING PRESS : 2306 MIN BEARING PRESS = 57 VOLUME OF CONCRETE

Section 12 Cell Formulas for Excel Spreadsheets







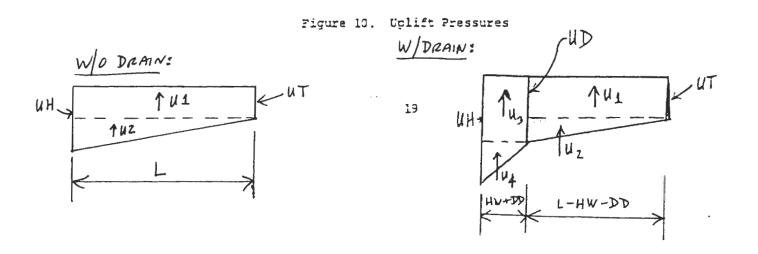
Pressure Head at Drains = $\frac{U_1 + R}{L} = \frac{(U_1 - U_1)}{L}$ (U2 - U1)

UT (V4)= Pressure Head at Toe

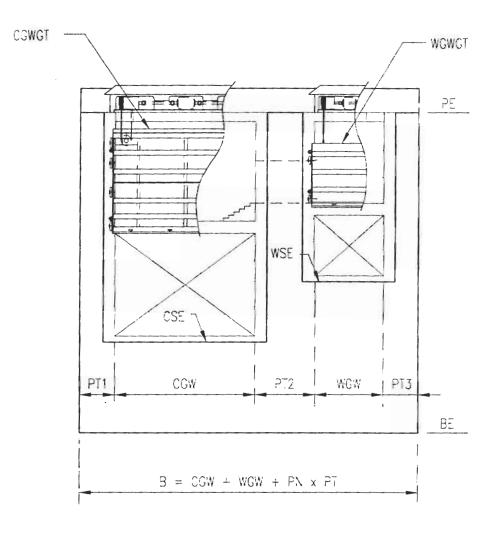
UH (V4)= Pressure Head at Toe

UH (1/2)= Pressure Head at Heel

R = Constant (100 - (25% -- 50%))



Gate Structure Stability Analysis (No Drains) Excel Spreadsheet with Cell Formulas Displayed



PT =
$$\frac{PT1+PT2+PT3}{3}$$
 = AVERAGE PIER THICKNESS
PN = NO. OF PIERS

LONGITUDINAL SECTION

1/16"=1'-0"

SCALE:

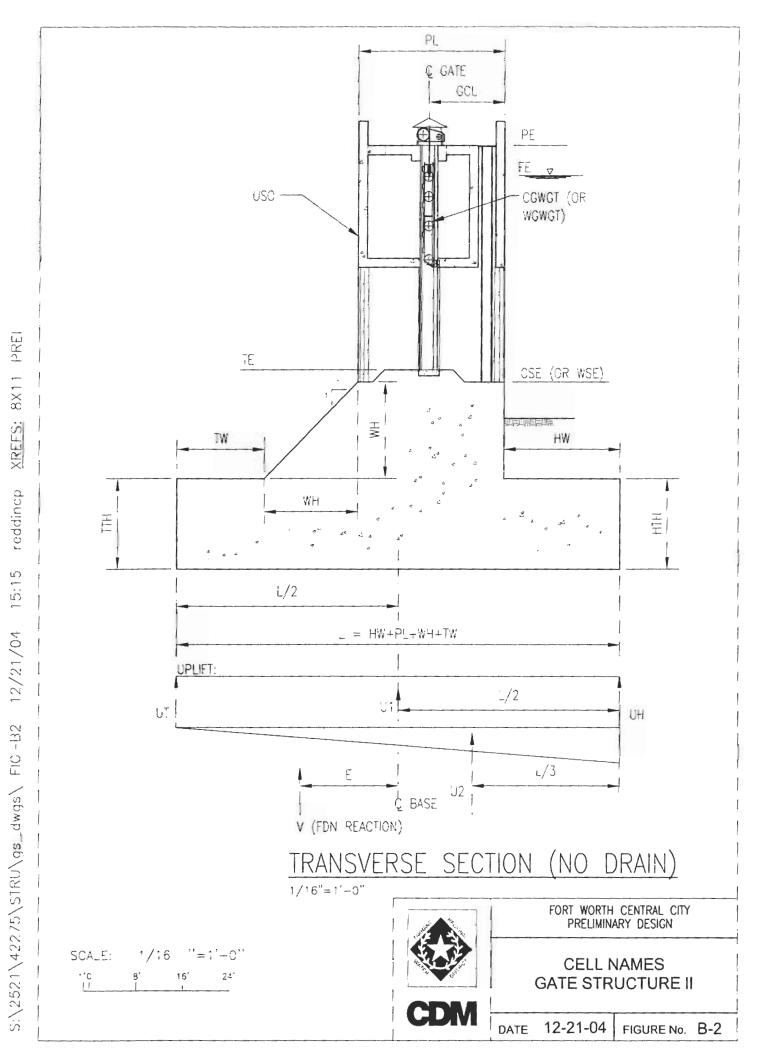


FORT WORTH CENTRAL CITY PRELIMINARY DESIGN

CELL NAMES GATE STRUCTURE I

DATE

12-21-04 | FIGURE No. B-1



PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275-PRSTR.DCS

DESIGNED BY: WCS

DATE: 12/18/2004

DATE:

CHECKED BY:

GATE STRUCTURE STABILLTY (W/ UPLIFT)
MAXIMIM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITIO

DIMENSIONS & WEIGHTS (INPUT):

	ΕŢ	1t	FI	FF	PT			FT	FT		FT	PT	LBS		FT	L.4	LBS	i,d	판교	FT	PT
GATE STRUCTURE:	FLOOD ELEV (FE): 556.5	TAILWATER RLEV (TE): 520	TOP OF PIER RLEV (PR): 557	FDN BASE EL (BE): 487	PIER LENGTH (PL): 25	PIER THICKNESS (PT); 7.33333333	NO. OF CONC PIERS (PN): 3	UPPER STRUCTURE OUTLINE (USO): 98	UPSTREAM FACE TO GATE CTR LINE (GCL):13	CHANNEL GATE:	GATE WIDTH (CGW): 24	SILL ELEV (CSE): 518	GATE WEIGHT (CGWGT): 15000	WALKWAY GATE:	GATE WIDTH (WGW): 12	SILL ELEV (WSE): 530	GATE WEIGHT (WGWGT): 5000	ADDL HEEL WIDTH (HW): 20	HEEL THICKNESS (HTH): 25	ADDL TOE WIDTH (TW): 20	TOE THICKNESS (TTH): 25

DESIGN PARAMETERS (INPUT):

Sagara	DECKERS	ASd	300	LCF	PCF	
PACTOR OF SAFETY (PS): 1.33	SE THAT PAGE TO THE PHILE (PHI): 35	ACTUAL SOLL FACTOR (SW) . 0	ACTUAL SOIL CORESTON (CN): 5	FILID PRESS (EFP): 62.5	CONT UNIT WGT (CUW): 150	

RESULTING DESIGN VALUES & DIMENSIONS:

DECREES PSF PSF	FT	FT	, FT
DESIGN FRICTION ANGLE (PHID): DEGREES (ATAN (TAN (RADIANS (PHI)) /FS)) DESIGN COHESION (CND): =CN/FS UPLIFT AT HEEL (UII): =(FE-BE)*EFP UPLIFT AT TOE (UT):: (TE-BE)*EFP	(Hutt-Ma-020 - ma)	5	E E
ID); · DEGREES (A'ND); = CN/FS UII); = (FE-BE)*E UI); : (TE-BE)*E	WII):=CSE-BE-TT	FDN LENGTH (L): =HW+PL+WH+TW	FDN WIDTH (B): =CGW+WGW+PN*PT
DESIGN FRICTION ANGLE (PHID): DEGREES (ATA) DESIGN COHESION (CND): =CN/FS UPLIFF AT HEEL (UI): =(FE-BE)*EFP UPLIFT AT TOE (UT): (TE-BE)*EFP	CONCRETE WEDGE HEIGHT & LGTH (WII) : =CSB-BE-TTH	FDN LENGTH	FDN WIDIII

DATE: =C5

=A3 =A5 =A7

=A1

LU*(WEIGHT CONC + GATES + WATER - UPLIFT)
COHESION * BASE AREA
= DRIVING FORCES MINUS ACTIVE RESISTING FORCES
= (FRICTION + COHESION) / (NET SLIDING)

Gate Structure Stability Analysis (with Drains) Excel Spreadsheet with Cell Formulas Displayed 8X11 PREL

XREFS:

reddincp

15:16

S:\2521\42275\STRU\gs_dwgs\ FIG-B3 12/21/04

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

DATE: 12/18/2004

DATE:

CHECKED BY:

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMIM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITI

DIMENSIONS & WEIGHTS (INPUT):

	JI	FT	FT	FI	F.E	17.0		FT	FT		1.4	r.T	LBS		FT	F.7	LBS	F	FT	FT	Ή
JRE:	(FE): 556.5	(TE): 520	(PE): 557	BE): 487	(PL):25	(PT): 7,3333333333	(PN): 3	86:(050)	(GCL): 13	GATE:	(CGW): 24	SE): 518	3T): 15000	ATF:	(WGW): 12	SE): 530	3T): 5000	(HW): 16	(HTII): 25	(TW): 20	('I"FH): 25
CATE STRUCTURE:	FLOOD ELEV (F	TAILWATER ELEV (1	TOP OF PIER ELEV (1	FDN BASE EL (F	PIER LENGTH (F	PIER THICKNESS (I	NO. OF CONC PIERS (I	UPPER STRUCTURE OUTLINE (US	UPSTREAM FACE TO GATE CTR LINE (GG	CHANNEL GA	GATE WIDTH (CO	SILL ELEV (CSE)	GATE WEIGHT (CGWGT):	WALKWAY GATE:	GATE WIDTH (WG	SILL ELEV (WSE)	GATE WEIGHT (WGWGT)	ADDL HEEL WIDTH (F	HEEL THICKNESS (H)	ADDL TOE WIDTH (1	TOE THICKNESS (1"

DESIGN PARAMETERS (INPUT):

```
DEGREES
                            PCF
                                                                                      Ή
ACTUAL SOIL FRICTION ANGLE (PHI):35
ACTUAL SOIL COHESION (CN):0
FLUID PRESS (EFP):62.5
CONC UNIT WGT (CUW):150
DRAIN EFFICIENCY (DE):0.33
DRAIN DIMENSION FROM HEADWALL (DD):10
```

RESULTING DESIGN VALUES & DIMENSIONS:

```
DESIGN PRICTION ANGLE (PHID):=DRGREES (ATAN (TAN (RADIANS (PHI)) /FS)) DEGREES

DESTGN COHESION (CND):=CN/FS

UPLIFT AT HEEL (UH):=(FE-BE)*EFP

UPLIFT AT TOE (UT):=(TE-BE)*EFP

ESP

FT

FDN LENGTH (L):=HW+PL+WH+TW

(L):=IW + PI, + WH + TW)

FT

FDN WIDTH (B):=CGW+WGW+PN*PT

(B = CGM + WGW + PN*PT)
```

DATE: =C5

=A3

#A1

= U*(WEIGHT CONG + GATES + WATER - UPLIFT) = COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES * (FRICTION + COMESION) / (NET SLIDING)

Gate Structure Seismic Analysis Excel Spreadsheet with Cell Formulas Displayed

PROJECT: TRWD - PLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

SUM DESIGNED BY:

DATE: 12/18/2004

DATE:

CHECKED BY:

GATE STRUCTURE STABLLITY (W/ UPLIFT)
NORMAL POOL ELEVATION WITH SEISMIC (EXTREME CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

Ē.	F.T	FT	FI	FT	FT		F.J	FT	ģ
525	520	557	206	25	7.333333333	3	98	13	Š
GATE STRUCTURE: FI.OOD ELEV (FE):	TAILWATER ELEV (TE):	TOP OF PIER ELEV (PE):	FDN BASE EL (BE):	PIER LENGTH (PL):	PIER THICKNESS (PT):	ro	UPPER STRUCTURE OUTLINE (USO) :	UPSTREAM FACE TO GATE CTR LINE (GCL):	CHANNEL GATE:

FT FT LES GATE WIDTH (CGW): 24 SILL ELEV (CSE): 518 GATE WEIGHT (CGWGT): 15000

FT FT LBS WALKWAY GATE:
GATE WIDTH (WGW): 12
SILL ELEV (WSE): 530
GATE WEIGHT (WGWGT): 5000 ADDL HEEL WIDTH (HW): 0
HEEL THICKNESS (HTH): 0
ADDL TOE WIDTH (TW): 17
TOE THICKNESS (TTH): 6

Gate Seismic-CellFormulas.XLS

DESIGN PARAMETERS (INPUT):

```
ACTUAL SOIL FRICTION ANGLE (PHI): 35
ACTUAL SOIL CORESION (CN): 0
PLUID PRESS (FFP: 62.5
CONC UNIT WGT (CUM): 150
SEISMIC COEFFICIENT (A): 0.05
SEISMIC COEFFICIENT (A): 0.05
SEISMIC COEFFICIENT (A): 0.05
SEISMIC COEFFICIENT (A): 0.05
DESIGN FRICTION ANGLE (PHID): =DEGREES (ATAN (TAN (RADIANS (PHI)) / FS)) PGREES
UPLIFT AT HEEL (UH): = (TE-BE)*EFP
UPLIFT AT TOE (UT): = (TE-BE)*EFP
FUN LENGTH (L): =HW*PL*WH+TW
(L = HW + FL + WH + TW)
FUN LENGTH (B): =CGW+WGW+FN*PT
(B = CGW + WGW + PN*PT)
FUN WIDTH (B): =CGW+WGW+FN*PT
(B = CGW + WGW + PN*PT)
```

Gate-seismic-CellFormulas.xLS

SESTMIC FIGURED CENTROLD OF MASS = 0.4 (PH-BE)
SESIMIC FIULD FORCE (PER NESTERGAARD) 0.67*51*A*(FE-BE)^2
FLUID FORCE RESULTANT ABOVE BASE 0.4*(FE-BE)
OK 0.4*(FE-BE)

SEISMIC PARAMETERS:

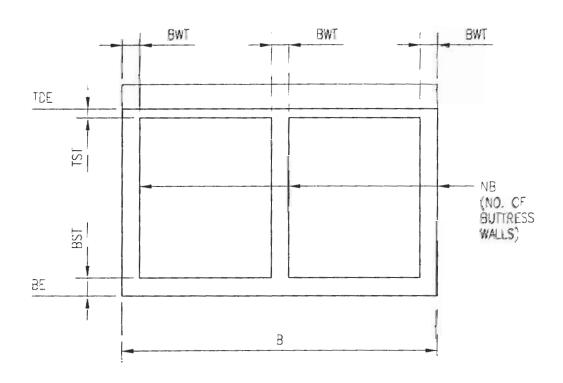
DATE: =C5

=A3 =A5 A7

= A 1

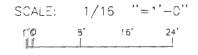
= U*(WEIGHT CONC + GATES + WATER - UPLLFT) = COHESTON * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESTON) / (NET SLIBING)

Abutment Structure Stability Analysis Excel Spreadsheet with Cell Formulas Displayed



LONGITUDINAL SECTION

1/16"=1'-0"





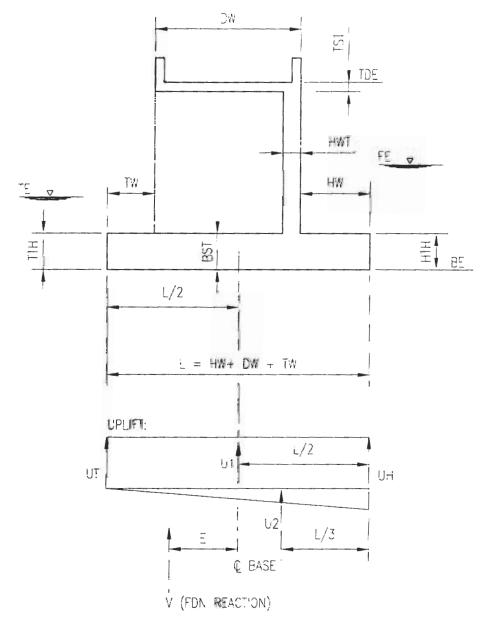
FORT WORTH CENTRAL CITY PRELIMINARY DESIGN

CELL NAMES
ABUTMENT STRUCTURE I

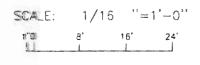
CDM

DATE 12-21-04

FIGURE No. B-4



TRANSVERSE SECTION 1/16"=1'-0"





FORT WORTH CENTRAL CITY PRELIMINARY DESIGN

CELL NAMES
ABUTMENT STRUCTURE II

CDM

DATE 12-21-04

FIGURE No. B-5

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: VCS

DATE: 12/18/2004

DATE:

CHECKED BY:

X

GATE ABUTMENT STRUCTURE STABILLITY MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

F.	LI	FT	ĽΙ	FT	FT	44		F	E	FT	L	TA	FT	LI
556.5	520	557	526	2.5	7	m	4	1.5	9	80	12	Ç	10	9
GATE ABUTMENT STRUCTURE:		TOP OF DECK ELEV (TDE):	FUN BASE EL (BE):	DECK WIDTH (DW):	HEADWALL THICKNESS (HWT):	BUTTRESS WALL THICKNESS (BWT):	NO. OF BUTTRESS WALLS (NB):	TOP SLAB THICKNESS (TST):	BOTTOM SLAB THICKNESS (BST):	STRUCTURE LENGT	ADDL HEEL WIDTH (HW):	HEBL THICKNESS (HTH):	ADDL TOE WIDTH (TW):	TOE THICKNESS (TTH):

DESIGN PARAMETERS (INPUT):

```
ACTUAL SOIL FRICTION ANGLE (PHI): 28
ACTUAL SOIL FRICTION (CN): 0
ACTUAL SOIL COHESION (CN): 0
FLUID PRESS (EFP): 62.5
CONC UNIT WGT (CUM): 150
CONTAINED SOIL WGT (CSW): 110
```

RESULTING DESIGN VALUES & DIMENSIONS:

```
=IF(TE-BE<0,0,-((TE-BE)^2*EFP/2*B))
                                                                                                                                                                                                                                                                                                                                                                                             =(FE-BE)^2*EFP/2*B
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         (RELATIVE TO CL)
                                                                                                                                                                                                                                                                                                                                                                                                                                                              =SUM(113:126)
                                                                                   LATL FORCE:
LB
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 >1.0?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       PSF
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  E E E
DATE: =C7
                                                                                                                                                  HEADWALL: = (TDE-TST-BE-BST)*HWT*(B-BWT*NB)*CUW
BUTTRESS WALLS(1): = (TDE-TST-BE-BST)*BWT*NB*DW*CUW
BUTTRESS WALLS(2): =0.5*(TDE-TST-2-BE-BST)*BWT*NH*TW*CUW
TOP SLAB: =TST*B*DW*CUW
BOTTOM SLAB: =BST*B*DW*CUW
                                                                                                                                                                                                                                                                                        TOE SIAB: =TW*TTH*B*CUW
FLUID ON HEEL: =HW*B*(FE-BE-HTH)*EFP
FLUID ON TOE: =IF(BE>TE,0,TW*B*(TE-BE-TTH)*EFP)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                FRICHTON FORCE (V*TAN(PHID)) = =V*TAN(RADIANS(PHID))
COHESTON FORCE (CND*L*B) = =CND*L*B

NET $LIDING FORCE = =128
SLIDING RATIO = = (H34·H35)/H36
OVERTURNING RATIO (MR/MO) = =MR/MO
ECCENTRICITY (E=L/2-(MR-MO)/V)) = =(L/2) ((MR MO)/V)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         BEARING PRESSURE = V/\iota, (1+6^{+}E/L)

MAX BEARING PRESS = eV/L^{+} (1+6^{+}E/L) /B

MIN BEARING PRESS = eV/L^{+} (1-6^{+}E/L) /B

JOILING OF CONCRETE = eV/L^{+} (1-6^{+}E/L) /B
                                                                                                                                                                                                                                                                                                                                                           UPLIFT FORCE (U1): =-UT*L*B
UPLIFT FORCE (U2): :-0.5*(UH:UT)*L*I3
PLUID HORIZ FORCE (H):
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    SUBTOTAL AT BASE (V,MR,MO) = =SUM(H13:H26)
                                                                                                                                                                                                                                                                   HEEL SLAB: =HW*HTH*B*CUW
                                                                                               WEIGHT:
                                                                                                                    LH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                STABILITY RESULTS:
                                                                          STABILITY ANALYSIS:
                                                                                                                                                                                                                                                                                                                                                                                                                              RESISTING FLUID FORCE:
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              VOLUME OF CONCRETE
```

DATE: =C5

=A3 =A5 A7

=A]

= U*(NEIGHT CONC | GATES | WATER - UPLIFT) = COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION) / (NET SLIDING)

Section 13 Design of H-Piles (Manual Calculations)





CLIENT TRWD

JOB NO. 42275

COMPUTED BY TOA

PROJECT GATE STR

DATE CHECKED 11-19-4

DATE 11-15-04

PAGE NO.

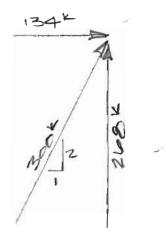
STEEL PILE CAPACITY

ASSUME:

4P14 x 102 MAY STRESS = 10.0 KSI AREA = 30 INZ

60 Purcy = 30102 (10,0 Ksi) = 300 K

FOR A Z:1 BATTER





CLIENT TRUD

JOB NO. 42275

COMPUTED BY BOA

PROJECT GATE TR

DATE CHECKED 11-1901

DATE 11-15-04

PAGE NO.

Rev. 12-21-04

STEEL PILE LAYOUT

ASSUME:

HP14 x 102 PILES

FIND BATTER ANGLE

FROM MAX LOAD CONDITIONS -TRWD GATE

PL = 3132K

TAND= 3132 = 0.438

1/0.438 = 2.3

USE 14: 2.5 V

Pv /R

HP14 x102

CAPACITY

MAX STRESS = 10 KSi

A = 30 INZ

Pmax = 300K

278.5× m/ 2.5



CLIENT TRUD PROJECT GATE STE	JOB NO	17275 11-19-01	COMPUTED BY	BDA 11-15-04
DETAIL TRUD	CHECKED BY	Ms	PAGE NO.	
		Rev. 12-21-60	+	

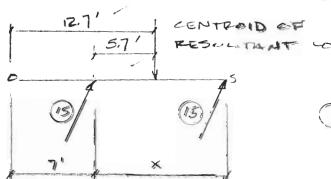
STEEL PILE LAYOUT

NUMBER OF PILES REQ'D BATTERED

& USE 30 PILES

PLE LOCATION

MAX LOAD CONDITION L= 35'-0" & = 4.84'





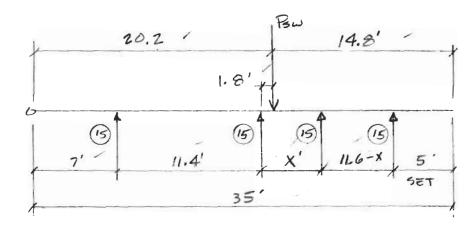
CLIENT	TRUD	JOB NO.		COMPUTED BY	BDA
PROJECT	GATE STR	DATE CHECKED	11-19-04	DATE _	11-15-04
DETAIL	TRWD	CHECKED BY	MOY	PAGE NO	

Rev. 12-21-04

STEEL PILE LAYOUT

PILE LOCATION

LOW WATER - MAKIMUM SERF WT.



ABOUT PSW

$$15 (13.2') + 15 (1.8') = 15 (x - 1.8') + 15 (9.8')$$

$$198 + 27.0 = 15 x - 27.0 + 147$$

$$x = 7.0$$

$$4 - Rows of 15 PILES EACH$$

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

DATE: 12/18/2004 DATE: 12/20/04

CHECKED BY: 2004

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

FDN BASE EL (BE): 496 FT CONC UNIT WGT (CUW): 150

RESULTING DESIGN VALUES & DIM

DESIGN FRICTION ANGLE (PHID): 27.77 DEGREES DESIGN COHESION (CND): 0 PSF	CONCRETE WEDGE HEIGHT & LGTH (WH): (WH = CSF-BE-TTH) FT FON LENGTH (I,): 35 FT	(L = HW + PL + WH + TW) FUN WIDTH (B) : 58 FT $(B - CGW + WGW + PV)$ *PT)
24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS	0 FT 0 FT 0 FT 12 FT
CHANNEL GATE: GATE WIDTH (CGW): SII,L ELEV (CSE): GATE WEIGHT (CGWGT):	WALKWAY GATE: GATE WIDTH (WGW): SILL ELEV (WSE): GATE WEIGHT (WGWGT):	ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE THICKNESS (TTH):

PROJECT: TRWD · FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/20/64 DATE: 12/18/2004

STABILITY ANALYSIS:

RESISTING MOME:NT: ARM TO TOE: LATL FURCE: WEIGHT:

OVERTURNING MOMENT:

> 330,000 110,000

CHANNEL GATE: WALKWAY GATE: CONCRETE PIERS:

15,000 3,217,500 1,058,400 3,795,000 1,173,000 1,530,000 WALKWAY BLOCK FDN: WALKWAY WEDGE FDN: CHANNEL WEDGE FDN: UPPER STRUCTURE: CHANNEL BLOCK FUN:

72,393,750 23,814,000 85,387,500 6,451,500 34,425,000

22.00 22.00 22.00 22.50 22.50 22.50 35.00 0.00

HEEL SLAB: TOE SLAB: 0

11,099,900

SUBTOTAL, AT BASE (V, MR, MO) =

224,594,750

0

STABILITY RESULTS:

 $|E=L/2-(MR-MO)/V)| = -2../3 \; (RFLATIVE 'IO CL) |$ BEARING PRESSURE = V/L(1+6*E/L)8031 PSF 2,736 CY 2905 PSF MAX BEARING PRESS = MIN BEARING PRESS = VOLUME OF CONCRETE = ECCEN'TRICITY (E=L/2-(MR-MO)/V))=

CLIENT TEWS

JOB NO. 42275

COMPUTED BY BOA

PROJECT GATE STR

DATE CHECKED 11-19-04

DATE 11-15-DETAIL TRINITY POINT

PAGE NO. ___

Rev. 12-21-04

STEEL PILE LAY OUT

ASSUME:

HP14×162 PILES

FIND BATTER ANGLE

FROM MAX LOAD CONDITIONS -TRIVITY PT. GATE

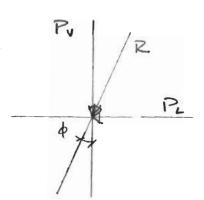
R = 7223 K

PL = 3798 K

TAN \$ = 3798 = 0.526

1/0.526 = 1.90

UNE 1H: ZV



HP 14 x 102

CAPA CITY

MAX STRESS = 10491

A = 30 INZ

Purary = 300 K



CLIENT	TRUD	JOB NO.	42275	COMPUTED BY	13DA
PROJECT	GATE TR	DATE CHECKED _	11-19-04	DATE	11-15-04
DETAIL	TRINITY POINT	CHECKED BY _	Jest .	PAGE NO.	
			Rev. 12-21-04		

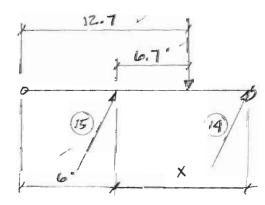
STEEL PILE LAYOUT

NUMBER OF PILES REQ'D BATTERED

30 USE 29 PILES -(VSE 30)

PILE LOCIATION

MAX LOAD CONDITION L= 37'-0" e= 5.77 -



$$15(6.7') = 14(x+6'-12.7')$$

$$100.5' = 14x + 84' - 177.8$$

$$X = 13.9'$$

$$504 14.0'$$





JOB NO. 42275 COMPUTED BY BOA CHECKED 3Y PAGE NC.

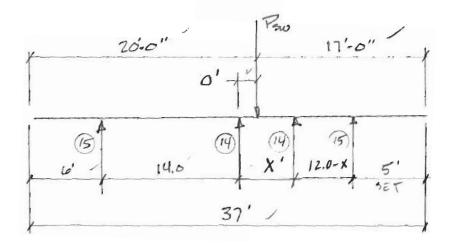
Rev. 12-21-04

STEEL PILE LAYOUT

PILE LOCATION

LOW WATER - MAXIMUM SELF WT.

Psw = 10,544.2x e= 1.45'



ABOUT PSW

$$15(14.0') + 14(8') = 14(x \cdot 0') + 15(12')$$

 $210' = 14x + 180'$
 $x = 2.1'$

USE MIN 574 = 3.5'

20 X = 3,5 SAY USE 30 PILES:

4 x 15 x 268 = 16,080" > 10,544 " 0x

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 7304

DATE: 12/18/2004 DATE: 12/20/04

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

ACTUAL SOIL FRICTION ANGLE (PHI): 35 DEGREES ACTUAL SOIL COHESION (CN): 0 PSF PLUID PRESS (EFP): 0 PCF COMC UNIT WGT (CUW): 150 PCF RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): 27.77 DEGREES DESIGN COHESION (CND): 0 PSF	CONCRETE WEDGH HEIGHT & LGTII (WH): 6 FT (WH - CSE-BE TTII)
549.5 FT 520 FT 509 FT 25 FT 8 FT 4 98 FT 13 FT	24 FT 518 FT 115,000 LBS	24 FT 530 FT 10,000 LBS 4 FT 3 FT 3 FT 3 FT
CATE STRUCTURE: FLOOD ELEV (FE): TALLMATER ELEV (FE): TOP OF PIER ELEV (FE): PEN BASE EL (BH): PIER LENGTH (FL): PIER THICKNESS (PT): NO. OF CONC PIERS (PV): UPPER STRUCTURE OUTLINE (USO): UPSTREAM FACE TO GATE CTR LINK (GCL):	CHANNEL GATE: GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	WALKWAY GATES: GATE WIDTH - 2 GATES (WGW): SILL ELEV (WSE): GATE WEIGHT - 2 GATES (WGWCT): ADDL HEEL WIDTH (HW): HEEL, THICKNESS (HTH): ADDL YOE WIDTH (TW): TOR THICKNESS (TTH):

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE:

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: _

DATE: 12/20/04 DATE: 12/18/2004

OVERTURNING MOMENT:

300,000 200,000 28,929,600 38,745,000 38,745,000 714,096 5,040,000 RESISTING MOMENT: ARM TO TOE: LATE FORCE: WEIGHT: CHANNEL GATE: WALKWAY GATE: STABILITY ANALYBIS:

20.00 20.00 20.50 20.50 20.50 1.00.50 15,000 10,000 4,680,000 1,411,200 1,890,000 1,890,000 1,890,000 1,890,000 1,890,000 1,890,000 1,890,000 CONCRETE PIERS:
UPPER STRUCTURE:
CHANNEL BLOCK FDN:
CHANNEL WEDGE FDN:
WALKWAY BLOCK FDN:
WALKWAY BELOCK FDN:
WALKWAY HEEL SIAB:
TOE SLAB:

10,544,200 SUBTOTAL AT BASE (V,MR,MO):

0

210,351,920

0

STABILITY RESULTS:

1.45 (RELATIVE TO CL) ECCENTRICITY (E=L/2-(MR-MO)/V)) 1 1.45 (REL BEARING PRESSURE = V/L(1++6*E/L) MAX BEARING PRESS 2725 PSF MIN BEARING PRESS 4400 PSF VOLUME OF CONCRETE 2,597 CY

CLIENT TRUN JOB NO. 47275 COMPUTED BY BDA
PROJECT CATE STR. DATE CHECKED 11-15-04 DATE 11-15-04 DETAIL CUENT FURK PAGE NO. CHECKED BY ______ Rev. 12-21-64

STEEL PILE LAYOUT

ASSOME:

HP 14 x 102

FIND BATTER ANGLE

FOROM MAX LOAD CONDITIONS - CLEAR FACK GATE

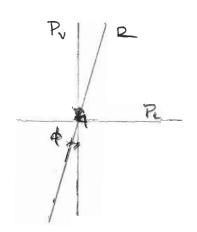
Py: 41824

P. = 4267k

TAND = 4267 = 1.02

1/1.02 = 0.98

USE 14:2V



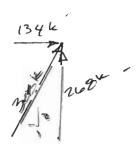
AP14x102

CAPACITY

MAK STRESS = 10KSI

A = 30,N2

Pmay = 300 x



No. OF PILES



CLIENT TRUD PROJECT GATE STR DETAIL WEAR FORK DATE CHECKED 11-19-4 CHECKED BY

JOB NO. 42275 COMPUTED BY FDA DATE 11-16-04 PAGE NO.

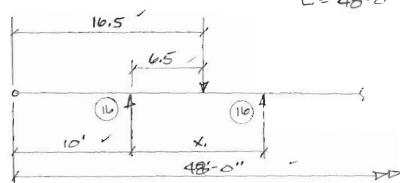
Rev. 12-21-04

STEEL PILE LAYOUT

MAY NODRAIN PILE CASE

MAT LOAD CONDITION

L= 48-0" / e= 7.56 /



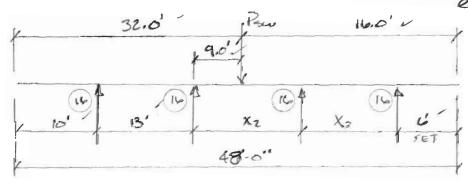
$$16(6.5') = 16(x_1 + 10 - 16.5')$$

 $104 = 16x_1 + 160 - 264$
 $x_1 = 13.0'$

PILE LOCATION

LOW WATER - MAXIMUM SELF WT. CASE

Psw = 8803 KIPS / e = 7.97



$$16(22.0') + 16(9.0') = 16(x_2 - 9.0') + 16(10.0')$$

$$352 + 144 = 16x_2 - 144 + 160$$

$$x_2 = 36.0'$$

IF X2 = 30' THEN THE TOTAL SUM OF LENGTH BETWEEN PILES IS GREATER THAN 48 00 NG



CLIENT	TRUD	JOB NO. 42275	COMPUTED BY BOA.
PROJECT	GATE STR	DATE CHECKED 12-21-04	DATE 12-20-04
DETAI_	CLEAR FORK	CHECKED BY	PAGE NO.

STEEL PILE LAYOUT

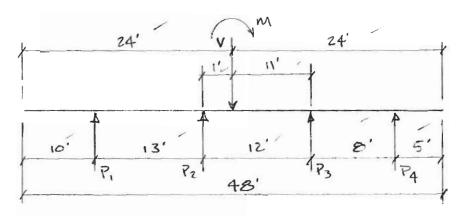
SELFWEIGHT CONDITION

TOTAL WEIGHT = 8803.12

ECCENTRICITY = 7.97F REL TO & OF STEUC.

SO MOMENT ON PILE GROUP

Mp = 8803.14 (7.97F) = 70,161F-4



MOMENT EFFECTS AT PILES

$$P_{1} = \frac{70.161^{5-1} (14')}{(14')^{2} + (10')^{2} + (11')^{2} + (19')^{2}} = \frac{1047^{2}}{679}$$

$$P_{2} = \frac{70.161^{5-1} (1.0')}{(14')^{2} + (1)^{2} + (11')^{2} + (19')^{2}} = \frac{103^{2}}{(14')^{2} + (1)^{2} + (11')^{2} + (19')^{2}} = \frac{103^{2}}{(14')^{2} + (11')^{2} + (11')^{2} + (19')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2} + (11')^{2} + (11')^{2} + (19')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2} + (11')^{2} + (11')^{2} + (19')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2} + (11')^{2} + (11')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2}} = \frac{1037^{2}}{(14')^{2} + (11')^{2}} = \frac{1037^{2}}{(14')^{2}} = \frac{103$$

MAXIMUM CASE

260k < 268 CAPACITY 50 0K

4 RWS OF 16 PILES BACH : 58' 3.63' SAY 3:6"SPACING COMB

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 9304

DATE: 12/18/2004

GATE STRUCTURE STABILITY (W/ UPLIFT)
MAXIMUM WATER LEVEL TO TOP OF LEVEE (UNUSUAL CONDITION)

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 35 DEGREES 0 PSF 0 PCF 150 PCF	27.'77 DEGREES 0 PSF	6 FT -BK-TTH) 48 FT	WH + TW) 58 FT + PN*PT)
ACTUAL SOII, FRICTION ANGLE (PHI): ACTUAL SOIL COHESTON (CN): FLUID PRESS (EFP): CONC UNIT WGT (CUW): RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): DESIGN COHESION (CND):	CONCRETE WEDGE HEIGHT & LGTH (WH): (WH = CSE-BE-TTH) FDN LENGTH (L): 48	(L - HW + PL, + WH + TW) FDN WIDTH (B): 58 (B - CGW + WGW + PN*PT)
506 FT 506 FT 557 FT 25 FT 7.33 FT 13 FT	24 FT 518 FT 15,000 LBS	12 FT 530 FT 5,000 LBS	0 FT 0 FT 17 FT 6 FT
GATE STRUCTURE: FLOOD ELEV (FE): TAILWATER ELEV (TE): TOP OF PLER ELEV (PE): PUN BASE EL (BE): PLER LENGTH (PL): PLER THICKNESS (PT): NO. OF CONC PLERS (PN): UPPER STRUCTURE OUTLINE (USO): TREAM FACE TO GATE CTR LINE (GCL):	CHANNEL GATE: (GATE WIDTH (CGW): SILL ELEV (CSE): GATE WEIGHT (CGWGT):	WALKWAY GATE: GATE WIDTH (WGW): SILL ELEV (WSE): GATE WEIGHT (WGWGT):	ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH): ADDL TOE WIDTH (TW): TOE 'THICKNESS (TTH):

PROJECT: TRWD · FLOOD GATE CONTROL, STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: _

DA'FE: 12/18/2004 DATE: 12/20/04

OVERTURNING MOMENT:	0
RESISTING MOMENT: 525,000 175,000 114,221,250 37,573,200 73,485,000 73,485,000 7,578,684 38,340,000 1,977,048	281,418,082
35.00 35.00 35.00 35.50 35.50 35.50 20.34 20.34 48.00 8.50	
LATL FORCE:	C
WEIGHT: LB LS 15,000 3,217,500 1,058,400 2,070,000 372,600 1,080,000 97,200 0	8,803,100
CHANNEL GATE: WALKWAY GATE: CONCRETE PIEKS: UPPER STRUCTURE: CHANNEL BLOCK FDN: CHANNEL WEDGE FDN: WALKWAY WEDGE FDN: WALKWAY WEDGE FDN: HEEL SLAB: TOE SLAB:	SUBTOTAL AT BASE (V, MR, MO) =

STABILITY RESULTS:

ECCENTRICITY (E=L/2-(MR MO)/V))= -7.97 (RELATIVE TO CL)

BEARING PRESSURE = V/L(1+-6*F/L)

MAX BEARING PRESS = 13 PSF

MIN BEARING PRESS = 6311 PSF

VOLUME OF CONCRETE = 2,169 CY

ART. 20.6

though the entire base may be in compression. However, unless the footing is greatly unsymmetrical, the errors involved in using eq. 20.7 are tolerable for design. The subject of bending on unsymbe necessary. If the resultant load does not coincide with the center of gravity of the area of the footing, the computation of the soil pressures becomes a problem involving bending on an unsymmetrical section. Theoretically, eq. 20.7 is not applicable even metrical sections has received adequate treatment elsewhere.

20.7. Moment on Pile Footings

articles concerning the pressure under soil-supported footings. Pile The reactions exerted by piles beneath a footing subject to moment are calculated in a manner similar to that described in the preceding caps, such as those shown in Fig. 20.5 and Fig. 20.6, are commonly

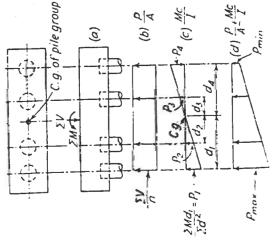


Fig. 20.5. Computation of pile reaction.

stant, the loads in the piles vary in the same planar fashion. Neither the assumption of the rigid cap nor the supposition that reaction is directly proportional to settlement is strictly valid, but each is gen-Finally, if the ratio of reaction to settlement is assumed to be conassumed to act as rigid structures. A planar distribution of the vertical settlement of the piles follows as a result of this assumption. erally considered sufficiently accurate for the purposes of design.

The analysis of a moment-resistant group of piles is illustrated in

MOMENT ON PILE FOOTINGS

in b. On the other hand, if there were no resultant vertical force and only ZM acted on the group of piles, the loads would be as If there were no moment and ZV acted through the center of gravity of the four piles, the leads in the piles would be as shown shown in c. Fig. 20.5.

The loads shown in d represent the total reaction and are the sums ZV acting eccentrically at a distance e to the left of the center of of those in b and c. The same loads would have been produced by gravity.

The following equation expresses this relationship if resisting moments From statics, it is evident that the resisting moment of the reactions at the junctions of the piles and the cap either do not exist or are furnished by the piles, Fig. 20.5c, must equal the applied moment, ΣM disregarded.

$$\leq M = P_1 d_1 + P_2 d_2 + P_3 d_3 + P_4 d_4$$
 20.8a

If the variation in pile reactions shown in c is assumed to be linear,

$$P_1/d_1 = P_2/d_2 = P_3/d_3 = P_1/d_4$$

or

$$P_2 \sim P_1 d_2/d_1; \quad P_3 = P_1 d_3/d_1; \quad P_4 = P_1 d_4/d_1$$

Substituting these values of P_2 , P_3 , and P_4 in eq. 20.8a, we have

$$2M = P_1 d_1^{-2}/d_1 + P_1 d_2^{-2}/d_1 + P_1 d_3^{-2}/d_1 + P_1 d_4^{-2}/d_1 - 20.8b$$

Solving for P1,

$$P_1 = \frac{\sum Md_1}{d_1^2 + d_2^2 + d_3^2 + d_4^2} = \frac{\sum Md_1}{\sum d^2}$$
 20.5

Similarly, the part of the load on any other pile due to moment may be computed by means of eq. 20.9 if d_1 is replaced by the distance from the pile to the center of gravity of the group.

The total reaction on any pile, found by adding the load shown in Fig. 20.5c to that in b_s may be expressed in the form of eq. 20.10.

$$P = \frac{\Sigma V}{n} \pm \frac{\Sigma Md}{\Sigma d^2}$$

P= total pile reaction resulting from moment and direct load where

 $\Sigma V = \text{sum of vertical loads acting on the foundation}$

 $\Sigma M = \text{sum of moments about the center of gravity of the}$ group. ΣM is sometimes expressed as ΣVe .

n = number of piles in the group

Foundation Engineering by Peck, Hanson, and Thornburn

 $d=\operatorname{distance}$ from the center of gravity of the group to pile in question

 $\Sigma d^2 = \text{sum of the squares of the distances to each pile from the center of gravity of the group$

Inspection of eq. 20.10 reveals that it is no more than a special form of the basic formula for stress on a section or for pressure beneath a soil-supported footing when either is subjected simultaneously to direct load and moment. The number of piles n is sub-

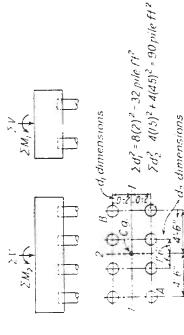


Fig. 20.6. Group of piles subjected to direct load and to moments about both axes.

stituted for the area, and the term $\mathbb{Z}d^2$ replaces the moment of inertia of the area. For this reason $\mathbb{Z}d^2$ is sometimes called the moment of inertia of the group of piles. The analogy between the terms of the two equations is shown in Fig. 20.5.

Most groups of piles contain several rows. Furthermore, moment about both axes is not uncommon. Equation 20.11 applies to these conditions.

$$P = \frac{\Sigma V}{n} + \frac{\Sigma M_1 d_1}{\Sigma d_1^2} \pm \frac{\Sigma M_2 d_2}{\Sigma d_2^2}$$
 20.11

The subscript of the moment denotes the centroidal axis about which the moment acts. The subscript of the distance indicates the centroidal axis to which the distance from the pile is measured. These symbols are shown in Fig. 20.6.

If the moments have the directions shown in Fig. 20.6, it is apparent that pile A carries the greatest load whereas pile B carries the least. Both $\mathbb{Z}M_1$ and $\mathbb{Z}M_2$ increase the reaction at A and decrease that at

ART. 20.9 BRIDGE PIER

B. Thus, it is possible to select by inspection the proper signs in the application of eq. 20.11 to any pile.

The determination of $\mathbb{Z}d^2$ for large groups of piles may be considerably simplified by the use of eq. 20.12 which applies to a single row of piles with equal spacing.

$$\Sigma d^2 \text{ (one row)} = \frac{s^2}{12} n_1 (n_1^2 + 1)$$
 20.12

where s = spacing of piles in the row

 $n_1 =$ number of piles in the row

20.8. Piles Subjected to Tension

Ordinarily the piles beneath a footing are expected to act in compression, and only nominal provision is made to anchor them to the footing. This condition exists whenever all the pile reactions computed in accordance with eq. 20.10 and 20.11 are positive. If some of the reactions are negative but the piles are not anchored to the cap, the situation is analogous to that described in Arts. 20.3 and 20.5 which deal with footings having only part of their bases in compression. If the piles corresponding to the negative reactions cannot resist the tensile forces, the compression in the other piles is increased.

On the other hand, piles are often used specifically to resist tensile forces beneath several common types of structures such as towers, gas storage tanks, and tall stacks. Beneath such structures the tensile forces are usually temporary and are almost always caused by the moment due to wind. Under these conditions, if the piles are capable of wit, standing tension and are adequately anchored to the eap, the loads in each pile may be computed by means of eq. 20.10 and 20.11.

20.9. Illustrative Design. DP D-4. Bridge Pier

The base of a bridge pier is a common example of a footing subjected to vertical loads together with moment about both axes. The vertical loads are due to the dead weight and live load of the superstructure and to the weight of the pier itself. Moments and shears on the foundation are produced by horizontal forces such as centrifugal force and those due to traction, nosing, wind, current, and ice. For the most unfavorable combination of these loadings, the allowable soil pressure or pile reaction beneath the base is commonly increased from 25 to 50 per cent above the value permitted under dead plus live load.



PROJECT GATE STR DATE CHECKED 12-21-04 DATE 12-20-04

DETAIL ABUTWENTS CHECKED BY PAGE NO.

ABUTMENT SUMMARY

(1) CFORK E 80 / 3451* / 2326* / 23' / 1223* / 669* / 3451* / 2326* / 646* / 380* / 646* / 264* / 26

GROUPING OF SIM, LATERAL LOADING

CFORKE

2326 K

ASSUME A 14:2V BATTER

HP14 x 102

PMANE = 300 K

134K



CLIENT	TRWD	JOB NO.	42275	COMPUTED BY	BDA
PROJECT	GATE STR	DATE CHECKED	12-2+04	DATE	12.20.04
DETAIL	ABUTWENTS	CHECKED BY	hen	PAGE NO.	

NUMBER OF PILES REQ'D

PRODE 2 Rous OF 5 PILES AT CEARN \\
\frac{23'}{5} = 4.6' SAY 416' SPACING



CLIENT	TRUD	JOB NO.	42275	COMPUTED BY	BDA
PROJECT	GATE STR.	DATE CHECKED	12-21-64	DATE	12-20-04
DETAIL	ABUTMENTS	CHECKED BY	M	PAGE NO.	

NUMBER OF PIVES REA'D

3 T. POINT E/W & TRWD W
LAT 380k = 3 PILES/RIW
VERT 51512 2 PILES/POW 2694 FL
SELFUT 1016 = 4 PILES TOTAL 268+ IPL
SAM PROVIDE 2 ROWS OF 5 PILES (MIN)
TPWD = \frac{22'}{5} = 4.40' Say 4'.4" SPACIAL AT T. POINT
134 × IPL = A PILES 26 = 5.2'
VERT 11194 . 5 PILES AT TRUD W
SELFUE 1865 = 7 PILES
268×1PL
PROVIDE 2 ROWS OF 7 DIES
3 TRWD W
134 K/PL = 2 PILES
VERT 2084/PL = 3 PILES
2684/PL = 4 PILES
PROVIDE 2 ROWS OF 5 PINES (MIN)

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DATE: 12/20/04 DATE: 12/18/2004 DESIGNED BY: WCS

CHECKED BY: BOA

GATE ABUTMENT STRUCTURE SELF-WEIGHT

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33	0 9	FLOUD PRESS (BEF): 0.150 PCF	110			ON COMPANY OF THE PROPERTY OF	RESULTING DESIGN VALUES & DIMENSIONS:	DESIGN FRICTION ANGLE (PHID): 21.79 DEGREES		DESIGN COHESION (CND): 0 PSF	(SH / NO - CINO	AUG CONTRACTOR OF THE CONTRACT	UPLIFT AT TEEL (UII): C.EN. (UII): (UII = (FE-BE) * KFP)	UPLIFT AT TOE (UT): 0 PSF	(UT : (TE-BK) * FFP)
FT	F	FT	F	I I			FT	ŀΤ	FT	Ē	1	ΕŁ	E		
526	557	526	25	N M	4	1.5	9	80	1.2	.,	Đ	10	9		
GATE ABUTMENT STRUCTURH: FLOOD BLEV (FE):	TOP OF DECK FLEV (TDE):	FDN BASE EL (BE):	DECK WIDTH (DW):	HEADWALL THICKNESS (HWT):	NO. OF BUTTRESS WALLS (NH):	TOP SLAB THICKNESS (TST):	BOTTOM SLAH THICKNESS (BST):	STRUCTURE LENGTH (B):	· (MII) HUMIN IDAN INCA	COLUMN TERM TOTAL	HEEL THICKNESS (HIII):	ADDI, TOE WIDTH (11W):	TOE THICKNESS (TTH):		

FIN LENGTH (L): 47 FT (L = HW + DW + TW)

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTW.DCS

DESIGNED BY: WCS

CHECKED BY: 15284

DATE: 12/18/2004 DATE: /2/20/04

OVERTURNING MOMENT:		С	R - UPLIFT) ESISTING FORCES IDING)
RESISTING MOMENT:	16,299,600 23,793,750 1,290,645 10,125,000 40,500,000 35,424,000 3,600,000	131, 032 ,995	= U* [WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES = (FRICTION + COHESION) / (NET SLIDING) L)
ARM TO TOE:	34.00 22.50 6.67 22.50 22.50 41.00 5.00		= U* [WEIGHT CONC + GAT COHESION * BASE AREA = DRIVING FORCES MINUS = (FRICTION + COHESION CL)
LATT, FORCE:		0	0 LB = 0 LB + 11 PSF
WEIGHT: LB	479,400 1,057,500 193,500 450,000 1,800,000 720,000 720,000	5,564,400	2,224, V/L(1+-6*F)
STABILITY ANALYSIS:	HEADWALL: BUTTRESS WALLS(1): BUTTRESS WALLS(2): TOP SLAB: HEEL SLAB: FLUID ON HEEL: FILUID ON TOE:	SUHTOTAL AT BASH (V,MR,MO)=	FRICTION FORCE (V*TAN(PHID)) = 2,224,544 COHESION FORCE (CND*L*B) NET SLIDING FORCE (CND*L*B) NECENITALCITY (E-L/2-(MR-MO)/V)) HAX BEARING PRESSUR = V/L(1+-6*F/L) MAX BEARING PRESS = 1471 MIN HEARING PRESS - 1471 VOLUME OF CONCRETE = 1,374

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/20/04 DATE: 12/18/2004

GATE ABUTMENT STRUCTURE SRLF-WEIGHT

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

1.33 28 DEGREES 0 PSF 0 PCF 150 PCF 110 PCF FACTOR OF SAFETY (FS):
ACTUAL SOLL FRICTION ANGLE (PHI):
ACTUAL SOLL COHESION (CN):
FLUID PRESS (EFP): CONC UNIT WGT (CUW): CONTAINED SOIL WGT (CSW): 2 FT 3 FT 7.5 FT 6 FT 23 FT FT FT FT FT FT 526 520 557 526 25 PON BASE RL (BF):
DECK WIDTH (DW):
HEADWALL THICKNESS (HWT):
NO. OF BUTTRESS WALLS (NF):
TOP SLAB THICKNESS (TST):
HOTTON SLAB THICKNESS (BST): FLOOD ELEV (FE): TAILWATER ELEV (TE): TOP OF DECK KLEV (TDE): GATE ABUTMENT STRUCTURE:

RESULTING DESIGN VALUES & DIMENSIONS:

21.79 DEGREES (CND = CN / FS) UPLIFT AT HEEL (UH): 0 (UH = (FE-BE) * EFP) (UT = (TE-BE) * RFP) DESIGN FRICTION ANGLE (PHID): 21.79 (PHID = ARCTAN(TAN(PHI)/FS))
DESIGN COHESION (CND): 0 UPLIFT AT TOR (UT):

> FT FT FT FT 12 6 8 6

> > ADDL TOR WIDTH (TW): TOE THICKNESS (TTH):

ADDL HEEL WIDTH (HW): HEEL THICKNESS (HTH):

STRUCTURE LENGTH (B):

FI FDN 1.ENGTH (L.): 45(1. = 35M + DM + TW)

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275 PRSTR. DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/18/2004 DATE: 12/20/04

OVERTURALING MOMENT:		٥
RESISTING MOMENT:	3,835,200 10,839,375 413,006 2,652,188 10,608,750 9,687,600 662,400	38,698,519
ARM TO TOE:	32.00 20.50 5.34 20.50 20.50 39.00	
LATL FORCE: LB		C
WEIGHT: LB	119,850 528,750 77,400 129,375 517,500 248,400	1,786,875
STABILITY ANALYBIS:	HEADWALL: BUTTRESS WALLS(1): BUTTRESS WALLS(2): TOP SIAN: BOTTOM SLAH: HEEL SLAB: TOE SIAB:	SUBTOTAL AT BASE (V,MR,MO)=

STABILITY RESULTS:

= U*(WEIGHT CONC + GATES + WATER - UPLIFT)
COHESION * BASE AREA
= DRIVING FORCES MINUS ACTIVE RESISTING FORCES
(FRICTION + COHESION)/(NET SLIDING) 714,360 LB 0 LB 0 LB FRICTION FORCE (V*TAN(PHID)) = COHESION FORCE (CND*L*E) = NET \$LIDING FORCE =

ECCENTRICITY (E=L/2-(MR-MO)/V))=

REARING PRESSURE = V/L(1+-6*E/L)

MAX BEARING PRESS = 1920 PSF

MIN BEARING PRESS = 1532 PSF

VOLUME OF CONCRETE = 441 CY

SELFWGT-Abut-W CFork.XLS

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: DOG

DATE: 12/18/2004 DATE: 72/20/04

GATE ABUTMENT STRUCTURE SELF-WEIGHT DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

	FACTOR OF SAFETY (FS): 1.53	0 0	0 0	(F,T,F);	(COM): 130					RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID): 21.79 DEGREES	_	DESIGN COHESION (CND): 0 FOF	- F3	UPLIFT AT HEEL (UH): 0 PSF	THE *	UPLIET AT TOE (UT): 0 PSF	(UT (TEBE) * HFP)
	FΉ	ĿТ	FT	ĽΔ	ЬJ	F.I.	F,I		F'T	БŢ	균		۲٠٦	F.1,	ΤΉ	FT			
	526	520	557	526	22	7	7	?	1.5	£	22		0	0	9	3			
GATE ABUTIMENT STRUCTURE:	FLOOI) ELEV (FE):	TAILWATER ELEV (TE):	TOP OF DECK ELEV (TDE):	FDN BASE EL (BE):	DECK WIDTH (DW):	HEADWALL THICKNESS (HWT):	HUTTRESS WALL THICKNESS (BWT):	NO. OF BUTTRESS WALLS (NR):	TOP SLAB THICKNESS (TST):	ROTTOM SLAB THICKNESS (BST'):	STRINGTIRE LENGTH (B):		ADDL HEEL WIDTH (HW):	HEEL THICKNESS (HTH):	ADDI TOE WINTH (TW):	TOE THICKNESS (T'I'H):			

FDN LENGTH (L): 31 FT (L - 11W + 1W)

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/18/2004

DATE: 12/20/04/	
1504	STABILITY AMALYSIS:

OVERTURNING MOMENT:		0
RESISTING MOMENT:	4,293,000 7,353,750 176,488 2,289,375 4,578,750 0	18,869,563
ARM TO TOE:	30.00 18.50 4.00 18.50 18.50 31.00	
LATL FORCE: ARM TO TOE:		0
WEIGHT: LB	143,100 397,500 44,100 123,750 247,500 59,400	1,015,350
	HEADWALL: BUTTRESS WALLS(1): BUTTRESS WALLS(2): TOP SLAB: BOTTOM SLAB: HEEL SLAB: TOE SLAB:	SUBTOTAL AT BASE (V,ME,MO)=

ECCENTRICITY (E=L/2-(MR MO)/V)) = U*(WEIGHT CONC + GATES + WATER - UPLIFT)

ECCENTRICITY (E=L/2-(MR MO)/V)) = -3.08 (RELATIVE TO CL)

BEARING PRESSURE

WIN BEARING PRESS = 600 PSF

MIN BEARING PRESS = 2378 PSF

VOLUME OF CONCRETE - 251 CY

PROJECT: TRWD FLOOD GATE CONTROL, STRUCTURE

CHARGE NO.: 2521-42275 PRSTR. DGS

DESIGNED BY: WCS

спески ву: 734

DATE: 12/18/2004 DATE: 12/20/04

GATE ABUTMENT STRUCTURE SELF-WEIGHT

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

FACTOR OF SAFETY (FS): 1.33	ACTUAL SOIL FRICTION ANGLE (PIII): 28 DEGREES	ACTUAL SOIL, COHESION (CN): () PSF		(CIM):	CONTAINED SOIL, MGT (CSW): 110 PCF				RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID): 21,79 DEGREES	(PHID ARCTAN (TAN (PHI) /FS))	DESIGN COHESION (CND): (0 PSF	Z / FS	UPLIFT AT HEEL (UH): () PSF	(UH = (FE-28E) * EFP)	UPLIFT AT TOE (UT): 0 PSF	(UT = (TE-BE) * EFP)
TA	Ţ	БŢ	FT	F'I'	Ŧ	F.I.		F.	$_{ m FT}$	ĿΉ		F.I.	FT	1.4	FT			
526	520	557	526	25	~	2	m	1.5	m	53		0	С	0	0			
GATE ABUTMENT STRUCTURE:	TATIMATER ELEV (TE):	TOP OF DECK ELEV (TDE):	FUN BASE EL (BE):	DECK WIDTH (DW):	HEADWALL, THICKNESS (HWT):	HULTRESS WALL THICKNESS (BWT):	NO. OF BUTTRESS WALLS (NB):	TOP SLAB THICKNESS (TST):	BOTTOM SLAB THICKNESS (BST):	STRUCTURE LENGTH (B):		ADDI, HEEL WIDTH (HW):	HEEL THICKNESS (HTH):	ADDI TOE WIDTH (TW):	TOE THICKNESS (TTH):			

PROJECT: TRWD - FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR. DCS

DESIGNED BY: WCS

CHECKED BY:

DATE: 12/18/2004

DATE: 12/20/04

STRAITE WELLTERED					
9 4	WEIGHT: LB	LATL FORCE:	ARM TO TOE:	RESISTING MOMENT:	
HEADWALL:	373,650		24.00	8,967,600	
UTTRESS WALLS(1):	596,250		12.50	7,453,125	
BUTTRESS WALLS(2):	0		00.0	0	
TOP SLAB:	298,125		12.50	3,726,563	
BOTTOM SLAB:	596,250		12.50	7,453,125	
HEEL SLAB:	0		25.00	0	
SLAB:	0		0.00	0	
SUBTOTAL AT BASE (V, MK, MO) =	1,864,275	0		27,600,413	

OVERTURNING MOMENT:

ECCENTRICITY (E=L/2-(MR-MO)/V)) = "COHESION * BASE AREA = "UPLIFT")

BEARING PRESS MINUS ACTIVE RESISTING FORCES = "2.30 (RELATIVE TO CL)"

MAX BEARING PRESS = "629 PSF"

MIN BEARING PRESS = 2185 PSF

WOLUME OF CONCRETE = 460 CY

0

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521-42275-PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: TSOM

DATE: 12/18/2004 DATE: 12/20/04

GATE ABUTMENT STRUCTURE SELF-WEIGHT

DIMENSIONS & WEIGHTS (INPUT):

DESIGN PARAMETERS (INPUT):

	FACTOR OF SAFETY (FS): 1.33	ACTUAL SOIL FRICTION ANGLE (PHI): 28 DEGREES	ACTUAL SOIL CONESION (CN): 0 PSF	FLUID PRESS (EFP): 0 PCF	CONC UNIT WGT (CUW): 150 PCF	CONTAINED SOIL WGT (CSW): 110 PCF				RESULTING DESIGN VALUES & DIMENSIONS:		DESIGN FRICTION ANGLE (PHID): 21.79 DEGREES	(PMID = ARCTAN (TAN (PHI) / FS))	DESIGN COHESION (CND): 0 PSF	(CND CN / FS)	UPLIFT AT HEEL (UH): () PSF	(UH = (FE-BE) * BEP)	UPLIFT AT TOE (UT): 0 PSF	(UT = (TE-BE) * BFP)
	Į.	FТ	ř. L	ΕŢ	F.1.	ĿΙ	FT		F. I.	FT	ΕŢ		FT	FT	£Ξ	FT			
	526	520	557	526	25	2	2	2	1.5	3	3.6		0	0	0	0			
GAT'E ABUTMENT STRUCTURE:	FLOOD ELEV (FE):	TAILWATER FLEV (TE):	TOP OF DECK ELEV (TDE):	FUN BASE EL (BE):	DECK WIDTH (DW):	HEADWALL THICKNESS (HWT):	BUTTRESS WALL THICKNESS (BWT):	NO. OF BUTTRESS WALLS (NR):	TOP SLAB THICKNESS (TST):	BOTTOM SLAB THICKNESS (BST):	STRUCTURE LENGTH (B):		ADDL HEEL WIDTH (HW):	HEEL THICKNESS (HTH):	ADDL TOE WIDTH (TW):	TOE THICKNESS (TTH):			

FDN LENGTH (L): 25 FT (L IM + DM + TW)

PROJECT: TRWD FLOOD GATE CONTROL STRUCTURE

CHARGE NO.: 2521 42275 PRSTR.DCS

DESIGNED BY: WCS

CHECKED BY: 204

DATE: 12/18/2004 DATE: '2/20/9/

STABILITY ANALYSIS:

CIPPITITI WALLEDON	WEIGHT: LB	WEIGHT: LATL FORCE: LB	ARM TO TOE:	RESISTING MOMENT:	OVERTURNING MOMENT:
HFADWALL:	174,900		24.00	4,197,600	
BUTTRESS WALLS(1):	397,500		12.50	4,968,750	
BUTTRESS WALLS(2):	0		00.00	0	
TOP SLAB:	146,250		12.50	1,828,125	
HOTTOM SLAB:	292,500		12.50	3,656,250	
HEEL STAB:	0		25.00	C	
TOE SLAB:	0		00.00	0	
SUBTOTAL AT BASE (V,MR,MO)-	1,011,150	0		14,650,725	0

STABILITY RESULTS:

. U* (WEIGHT CONC + GATES + WATER - UPLIFT) COHESION * BASE AREA = DRIVING FORCES MINUS ACTIVE RESISTING FORCES (FRICTION + COHESION) / (NET SLIDING)	: TO CI.)
404,239 LB 0 LB 0 LB	-1.99 (RELATIVE TO CI.) /L(1+-6*E/L) 813 PSF 2298 PSF 250 CY
FRICTION FORCE (V*TAN(PHID))= COHESIÓN FORCE (CND*L'B)= NET SLIDING FORCE =	ECCENTRICITY (E=L/2-(MK MO)/V))= -1.99 BRARING PRESSURE = V/L(1+6*E/L) MAX BEARING PRESS = 813 MIN BEARING PRESS = 2298 VOLUME OF CONCRETE = 250

Section 14 Training Wall Stability Analysis and Design (CTWall Results and Manual Calculations)

CDM

```
CLIENT TRWD

JOB NO. 42275

COMPUTED BY

PROJECT FWCC

DATE CHECKED 12-20-2004

DATE 11-23-04

DETAIL TRAINING WALLS

CHECKED BY BDA PAGE NO.

Rev. 1/18/05
```

```
BASED ON PREZIMINARY ANALYSES, PUT TRAINING WALLS ON PILET
```

(EXCESSIVE FIG. LG. FOR STD. RTNG, WALL)

- ASSUME CHANNEL FILLED IN TO EL 512.0 (MIN) W

BASE OF WALL AT EL SUR,U

- ASSUME GRADE BEHIND WALL AT EL 530 i w/

TAP OF WAIL AT EL 533.50 /

BASED ON PREZIMINARY CTUPIL ANALYSES, USE 6'TOE & 26' TOTAL BASE:

I I NL DILE: O.T. RATIO = 1.54, 1009, COMPR. NET LATE FORIE = 31.9 K/. V

IINSPILE: " = = = 15.5 % V

I 4CLPILE: = 2.15, " , " = 37.6 %, v

I 4 C S PILE- " = 5.26 " = 25.3%. \"

I 1 FL PILE: = | 107' = 34.2 M. \"

CHECK BASE OF STEM FOR LADS FROM TALL PILE: | 18.2 M.

DETERMINE EAUX. LATERAL PRESSURE EL 530 TO 508:

EARTH LOAD: 28.052 = 1 8 (22')2: Se = 0.116 V

SURCHARICLE LOAD: 1.377 = 8, (22)2 : 8 = 0.0028 V

WATER LEAD: 8.196 = 18 0 (22') = 8 = 0.034 V

V C BASE OF STEM = 0.0028 (18) 2 + 2 (0,116+0.034)(18) 2 0.907 = 0.894 + 24.30 = 25.2 4/

 $V_u = 1.3 \times 1.7 \times 25.2 = 55.7 \%$

TRY 48 AT BOXE. Q Ve = 0.1075× 45"×12" = 58.0 % 755.7 ×/. EX M C BASE OF STEM = 0.0028 (18) /2 + $\frac{1}{6}$ (0.116 + 0.034) (18) = 8.2 + 145.8 × = 154, 1×1, 1 Mu = 1.3 × 1.7 × 154 = 340. 1×/. × = $\frac{340 \times 1000}{(45)^2}$ = 162, an= 4.37 × As = $\frac{340}{(4.37 \times 45)}$ = 1.73 N=/6+ > $\frac{4}{5}$ & WE 4"C" C BASE OF STEM



CLIENT	TRWD	JOB NO.	42275	COMPUTED BY	mes
PROJECT	FWEE	DATE CHECKED	12-20-2004	DATE	11-29-04
DETAIL	TRAINING WALLS	CHECKED BY	BDA	PAGE NO.	

$$K = \frac{340 \times 1000}{(51)^2} = 131^4, \ a_n = 4.39^4$$

$$A_5 = \frac{340}{4.39151} = 1.52 \text{ m}^2/\text{St} \implies \#806 = 1.58 \text{ m}^2/\text{St}$$

$$= \cdot \text{ VSE } 4^{1}6^{\prime\prime} \text{ @ BASE OF WALLY}$$

PILES: USE HP14 X102 @ Z:1 BATTER 134"

$$\frac{134^{11}}{38^{11}/34} = 3.53^{11}$$
 $\frac{134^{11}}{38^{11}/34} = 3.53^{11}$

VIE 2 RUS OF PIES O 7' SPACING (STAGGERED)

LUADON 2 ROWS OF PILES @ 7' SPANING.

SAY PRIVIDE I ROW OF VERTICAL PILES @ 7' SPACING?

LATERAL LOAD & BATTERED PILES = 60,9 × 134 = 30.5 FACH

- USE 2 RWS BATTERED UPSTREAM TO BALANCE LATERAL FORCE

Xo = 9.53' MEASURED From TOE:

SAY PIES & 7' FROM TOE & 12' FROM TOE

****** Echoprint of Input Data ***********

Date: **/11/23 Time: 10.47.26

Flood Wall Stability Analysis Using CTWALL

Filename: I1NLPILE.DAT

Company name:

CDM

Project name: TRWD-FWCC

Project location:

Fort Worth, TX / Tarrant Regional Water District

Wall location: Training Walls Computed by: WCS

Structural geometry data:

Elevation of top of stem (ELTS)	=	533.50	ft
Height of stem (HTS)	=	21.50	ft
Thickness top of stem (TTS)	=	1.50	ft
Thickness bottom of stem (TBS)	=	4.00	ft
Dist. of batter at bot. of stem (TBSR) =	.00	ft
Depth of heel (THEEL)	==	4.00	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	4.00	ft
Width of toe (TWIDTH)	=	6.00	fτ
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	26.00	£t
Depth of key (HK)	==	.00	ft
Width of bottom of key (TK)	=	.00	ft
Dist. of batter at bot. of key (BTRK)	=	.00	ft

Structure coordinates:

x (ft)	y (ft)
========	=======
.00	508.00
.00	512.00
16.00	512.00
18.50	533.50
20.00	533.50
20.00	512.00
26.00	512.00
26.00	508.00

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:

Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.	
Phi	C	Unit wt.	unit wt.	Delta	soil	
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)	
27.00	.000	.100	.130	.00	530.01	

Driving side soil geometry:

Soil point	Batter (in:1ft)	Distance (ft)
======	=========	========
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soil	X	У
point	(ft)	(ft)
=====		
1	-1081.91	546.68
2	-31.91	546.68
3	18.09	530.01

Resisting side soil property data:

		Moist	Saturated	Elev.	
Phi	С	Unit wt.	unit wt.	soil	Batter
(deg)	(ksf)	(kcf)	(kcf)	(ft)	(in:1ft)
27.00	.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	X	У
point	(ft)	(ft)
======		=========
1	26.00	508.00
2	526.00	508.00

Foundation property data:

```
phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .100 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .100 (ksf)
```

Water data:

Driving side elevation = 530.00 ft

Resisting side elevation = 524.30 ft

Unit weight of water = .0625 kcf

Seepage pressures computed by Line of Creep method.

Uniform load data:

Magnitude of load = .10 k/ft

Minimum required factors of safety:

Sliding FS = 1.50

Overturning = 100.00% base in compression

Crack options:

o Crack depth is to be calculated

o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

**** Summary of Results ****

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

****** *** *** Satisfied ***

Xr (measured from toe) = 8.67 ft Resultant ratio = .3336 Stem ratio = .2308

Base pressure at heel = .0025 ksfBase pressure at toe = 3.6358 ksf

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

To increase stability try one or a combination of the following:

- 1. Increase the base width
- 2. Slope the base of the structure
- 3. Lower the wall base
- 4. Add a key

```
****************** Output Results **************
Date: **/11/23
                                          Time: 10.47.26
Flood Wall Stability Analysis Using CTWALL
Filename: I1NLPILE.DAT
Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
 Training Walls
Computed by: WCS
*******
** Overturning Results **
*******
Solution converged in 1 iterations.
SMF used to calculate K's = .6667
Alpha for the SMF = -44.1002
Calculated earth pressure coefficients:
 Driving side at rest K = .4886
 Driving side at rest Kc = 1.1474
 Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
  Full passive K calculated for resisting side.
  50% of full passive will be used.
Depth of cracking =
** Driving side pressures **
 Water pressures:
   Elevation Pressure
               (ksf)
     (ft)
   ______
      530.00 .0000
      508.00 1.2117
 Earth pressures:
   Elevation Pressure
     (ft)
              (ksf)
   ______
      536.04 .0000
      530.00 .4500
515.76 1.3363
508.00 1.6203
```

Surcharge pressures:

Elev.	Press.
(ft)	(ksf)
========	=======
536.04	.049
508.00	.049

** Resisting side pressures **

Water pressures: Elevation Pre

Elevation	Pressure
(ft)	(ksf)
=========	
524.30	.0000
508.00	1.0187
508.00	1.0187

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
.00	1.2117
26.00	1.0187

	========	========		========
Part	Force	(kips)	Mom. Arm	Moment
	Vert.	Horiz.	(ft)	(ft-k)
	========	· :=========	=========	========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:	21.103		11.00	203.03
Moist soil	5.475		-19.96	-109.27
Saturated soil	39.889		-17.47	-696.70
Water above structure	.000		.00	.00
Water above soil	.000		.00	.00
External vertical loads	1.850		-16.75	-30.99
	1.050	.000	.00	
Ext. horz. pressure loads				.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:	0.00		0.0	0.0
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure	.000		.00	.00
Water above soil	4.612		-3.00	-13.84
Driving side:				
Effective earth loads		25.548	9.79	249.99
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		1.370	14.02	19.21
Water loads		13.329	7.33	97.73
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		-8.303	5.43	-45.12
Foundation:				
Vertical force on base	-47.299		-8.67	410.21
Shear on base		-31.944	.00	.00
Uplift	-28.996		-13.37	387.82
		========	=========	=========
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 47.299 kips
Shear force on base = 31.944 kips
Max. available shear force = 26.700 kips

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

Base pressure at heel = .0025 ksfBase pressure at toe = 3.6358 ksf

Xr (measured from toe) = 8.67 ft
Resultant ratio = .3336
Stem ratio = .2308
Base in compression = 100.00 %
Overturning ratio = 1.54

Volume of concrete = 6.04 cubic yds/ft of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

```
******
** Sliding Results **
******
```

Solution converged. Summation of forces = 0.

Wedge Number	Horizontal Loads (kips)	Vertical Loads (kips)
=======	==========	
1	.000	3.379
2	-8.303	6.462
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge	press.	press.	x-coord.	press.
number	(ksf)	(ksf)	(ft)	(ksf)
========	=======	========	=========	========
1	.0000	1.2117		
2			.0000	1.2117
2			26.0000	1.0187
3	.0000	.0000		

Points of sliding plane:

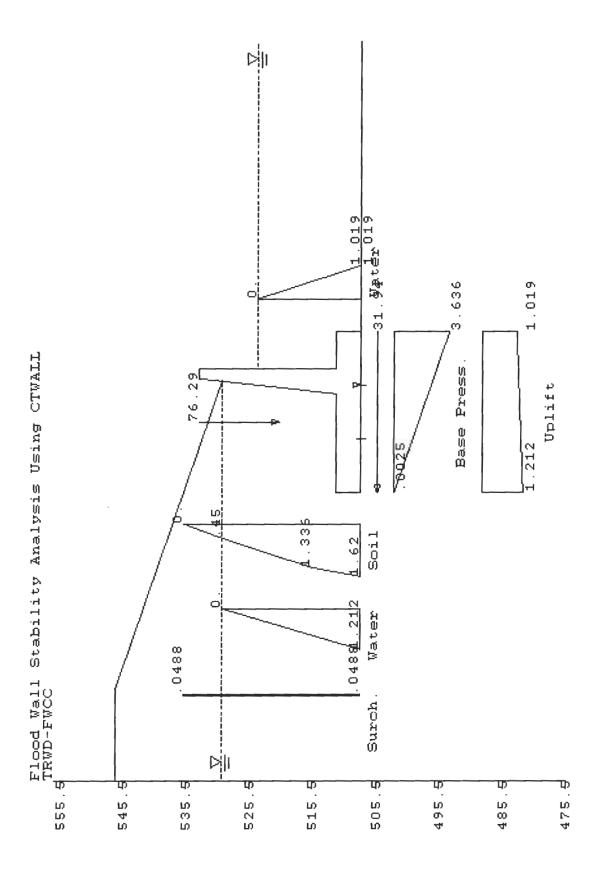
Point 1 (left), x = 0.00 ft, y = 0.00 ft Point 2 (right), x = 0.00 ft, y = 0.00 ft

Depth of cracking = .00 ft

	Failure	Total	Weight	Submerged	Uplift
Wedge	angle	length	of wedge	length	force
number	(deg)	(ft)	(kips)	(ft)	(kips)
======	=======	=======	========	========	=======
1	-48.862	51.355	54.711	29.212	17.698
2	.000	26.000	69.832	26.000	28.996
3	.000	.000	.000	.000	.000

Wedge	Net force
number	(kips)
========	=======
1	-33.348
2	33.348
3	.000
========	
SUM =	.000

| Factor of safety = 1.066 |



******* Echoprint of Input Data ************

Date: **/11/23

Time: 11.04.55

Flood Wall Stability Analysis Using CTWALL

Filename: I1NSPILE.DAT

Company name: CDM

Project name: TRWD-FWCC

Project location:

Fort Worth, TX / Tarrant Regional Water District

Wall location: Training Walls Computed by: WCS

Structural geometry data:

Elevation of top of stem (ELTS)	=	533.50	£t
Height of stem (HTS)	=	21.50	ft
Thickness top of stem (TTS)	=	1.50	ft
Thickness bottom of stem (TBS)	=	4.00	ft
Dist. of batter at bot. of stem (TBSR)) =	.00	ft
Depth of heel (THEEL)	=	4.00	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	4.00	ft
Width of toe (TWIDTH)	=	6.00	ft
Distance of batter for toe (BTRT)	=	.00	£t
Width of base (BWIDTH)	=	26.00	ft
Depth of key (HK)	=	.00	ft
Width of bottom of key (TK)	=	.00	ft
Dist. of batter at bot. of key (BTRK)	=	.00	ft

Structure coordinates:

x (ft)	y (ft)
========	=======
.00	508.00
.00	512.00
16.00	512.00
18.50	533.50
20.00	533.50
20.00	512.00
26.00	512.00
26.00	508.00

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:
Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.
Phi	С	Unit wt.	unit wt.	Delta	soil
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)
========	=======			======	======
.00	1.000	.100	.130	.00	530.01

Driving side soil geometry:

Soil	Batter	Distance
point	(in:1ft)	(ft)
=====	==========	
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soil	X	У
point	(ft)	(ft)
======	========	
1	-1081.91	546.68
2	-31.91	546.68
3	18.09	530.01

Resisting side soil property data:

?hi (deg)	c (ksf)	Unit wt.	Saturated unit wt. (kcf)	soil	Batter (in:1ft)
.00	1.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	X	У
point	(ft)	(ft)
======		========
1	26.00	508.00
2	526.00	508.00

Foundation property data:

phi for soil-structure interface = .00 (deg)
c for soil-structure interface = 1.000 (ksf)
phi for soil-soil interface = .00 (deg)
c for soil-soil interface = 1.000 (ksf)

Water data:

Driving side elevation = 530.00 ft Resisting side elevation = 524.30 ft
Unit weight of water = .0625 kcf

Seepage pressures computed by Line of Creep method.

Uniform load data:

Magnitude of load = .10 k/ft

Minimum required factors of safety:

Sliding FS = 1.50

Overturning = 100.00% base in compression

Crack options:

- o Crack *is* down to bottom of heel
- o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

```
***** Summary of Results *****
```

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

```
*****
            *** Satisfied ***
```

Required base in comp. = 100.00 % * Overturning * Actual base in comp. = 100.00 % Overturning ratio = 2.10 *****

Xr (measured from toe) = 11.43 ftResultant ratio = .4397 = .2308 Stem ratio

Base pressure at heel = 1.3075 ksfBase pressure at toe = 2.7911 ksf

***** *** Satisfied ***

* Sliding * Min. Required = 1.50 ******* Actual FS = 1.60

```
********************* Output Results ***************
Date: **/11/23
                                            Time: 11.04.55
Flood Wall Stability Analysis Using CTWALL
Filename: I1NSPILE.DAT
Company name:
 CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Training Walls
Computed by: WCS
** Overturning Results **
********
Solution converged in 1 iterations.
SMF used to calculate K's = .6667
Alpha for the SMF = -31.6073
Calculated earth pressure coefficients:
 Driving side at rest K = 1.0000
 Driving side at rest Kc = 2.4441
 Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
  Full passive K calculated for resisting side.
 50% of full passive will be used.
Depth of cracking =
                      14.94 ft
Crack extends to bottom of base of structure.
** Driving side pressures **
 Water pressures:
   Elevation Pressure
      (ft)
               (ksf)
   _______
      536.04 .0000
521.11 .9335
508.00 1.1291
 Earth pressures:
   Elevation Pressure
   _____
      536.04 .0C0C
521.11 .0000
508.00 .3068
```

Surcharge pressures:

Elev.	Press.
(ft)	(ksf)
========	=======
521.11	.100
508.00	.100

** Resisting side pressures **

Water pressur	res:
Elevation	Pressure
(ft)	(ksf)
=========	========
524.30	.0000
508.00	1.0187
508.00	.6412

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
========	========
.00	1.1291
26.00	.6412

** Forces and moments **

	========	.=========	==========	=========
Part	Force Vert.	(kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
	========		(10)	========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:			22.00	203.03
Moist soil	5.475		-19.96	-109.27
Saturated soil	39.889		-17.47	-696.70
Water above structure	.000		.00	.00
Water above soil	.000		.00	.00
External vertical loads	1.850		-16.75	-30.99
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:				
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure	.000		.00	.00
Water above soil	4.612		-3.00	-13.84
Driving side:				
Effective earth loads		2.010	4.37	8.78
Shear (due to delta)	.000		.00	.00
Foriz. surcharge effects		1.311	6.55	8.59
Water loads		20.487	10.34	211.84
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		-8.303	5.43	-45.11
Foundation:				
Vertical force on base			-11.43	609.09
Shear on base		-15.505	.00	.00
Uplift	-23.013		-14.19	326.65
	========	=========	=========	========
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 53.282 kips
Shear force on base = 15.505 kips
Max. available shear force = 26.000 kips

Base pressure at heel = 1.3075 ksf Base pressure at toe = 2.7911 ksf

Xr (measured from toe) = 11.43 ft
Resultant ratio = .4397
Stem ratio = .2308
Base in compression = 100.00 %
Overturning ratio = 2.10

Volume of concrete = 6.04 cubic yds/ft of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

Solution converged. Summation of forces = 0.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	(kips)	(kips)
=======	========	
1	.000	.000
2	16.270	6.462
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge number	press. (ksf)	press. (ksf)	x-coord. (ft)	press. (ksf)
=======	=======	========	=========	========
1	.0000	.0000		
2			.0000	1.3750
2			26.0000	.6412
3	.0000	.0000		

Points of sliding plane:

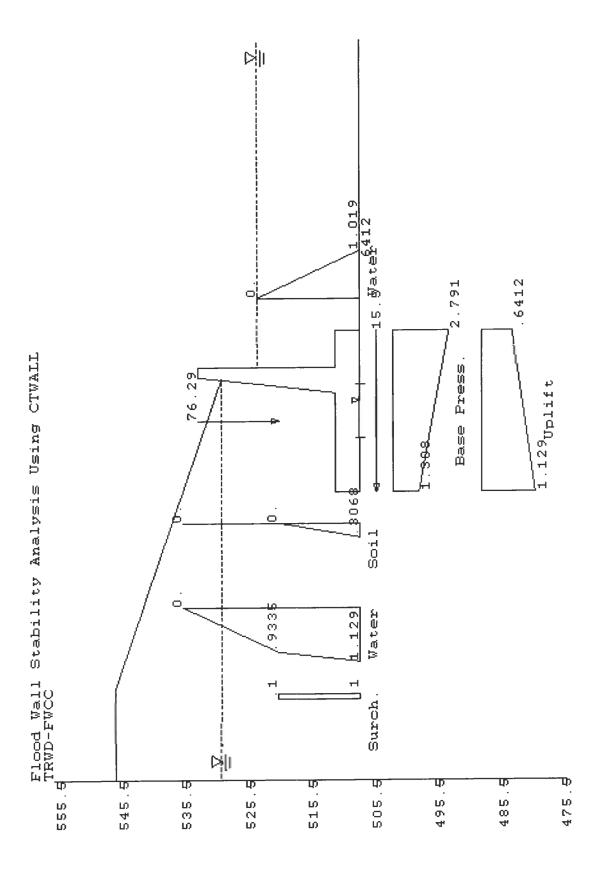
Point 1 (left), x = 0.00 ft, y = 508.00 ftPoint 2 (right), x = 26.00 ft, y = 508.00 ft

Depth of cracking = 28.04 ft Crack extends to bottom of base of structure.

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
======	=======	=======		========	=======
1	.000	.000	.000	.000	.000
2	.000	26.000	69.832	26.000	26.210
3	.000	.000	.000	.000	.000

Wedge	Net force
number	(kips)
=======	========
1	.000
2	.001
3	.000
=======	=======
SUM =	.001

| Factor of safety = 1.598 |



```
****** Echoprint of Input Data ************
Date: **/11/23
                                           Time: 10.48.50
Flood Wall Stability Analysis Using CTWALL
Filename: I4CLPILE.DAT
Company name:
 CDM
Project name:
 TRWD-FWCC
Project location:
 Fort Worth, TX / Tarrant Regional Water District
Wall location:
 Training Walls
Computed by: WCS
Structural geometry data:
 Elevation of top of stem (ELTS) = 533.50 ft
```

Elevation of top of stem (ELTS) = 533.50 ft
Height of stem (HTS) = 21.50 ft
Thickness top of stem (TTS) = 1.50 ft
Thickness bottom of stem (TBS) = 4.00 ft
Dist. of batter at bot. of stem (TBSR) = .00 ft
Depth of heel (THEEL) = 4.00 ft
Distance of batter for heel (BTRH) = .00 ft
Width of toe (TTOE) = 4.00 ft
Distance of batter for toe (BTRT) = .00 ft
Width of base (BWIDTH) = 26.00 ft
Width of base (BWIDTH) = 26.00 ft
Depth of key (HK) = .00 ft
Width of bottom of key (TK) = .00 ft
Dist. of batter at bot. of key (BTRK) = .00 ft

Structure coordinates:

x (ft)	y (ft)
========	======
.00	508.00
.00	512.00
16.00	512.00
18.50	533.50
20.00	533.50
20.00	512.00
26.00	512.00
26.00	508.00

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:
Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.
Phi	С	Unit wt.	unit wt.	Delta	soil
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)
========	=======	=======		======	=======
27.00	.000	.100	.130	.00	530.01

Driving side soil geometry:

Soil	Batter	Distance
point	(in:1ft)	(ft)
======		========
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soil	x	У
point	(ft)	(ft)
=====	=========	========
1	-1081.91	546.68
2	-31.91	546.68
3	18.09	530.01

Resisting side soil property data:

		Moist	Saturated	Elev.	
Phi	С	Jnit wt.	unit wt.	soil	Batter
(deg)	(ksf)	(kcf)	(kcf)	(ft)	(in:1ft)
========	=======	=======	========	======	
27.00	.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	X	У
point	(ft)	(ft)
======	=========	========
1	26.00	508.00
2	526.00	508.00

Foundation property data:

phi for soil-structure interface = 27.00 (deg) c for soil-structure interface = .100 (ksf) phi for soil-soil interface = .27.00 (deg) c for soil-soil interface = .100 (ksf)

Water data:

Driving side elevation = 530.00 ft
Resisting side elevation = 508.01 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

Uniform load data:

Magnitude of load = .10 k/ft

Minimum required factors of safety:

Sliding FS = 1.33

Overturning = 75.00% base in compression

Crack options:

o Crack depth is to be calculated

o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

***** Summary of Results *****

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

 $Xr mtext{(measured from toe)} = 9.53 mtext{ ft}$ Resultant ratio = .3667 Stem ratio = .2308

Base pressure at heel = .4771 ksfBase pressure at toe = 4.2912 ksf

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

To increase stability try one or a combination of the following:

- 1. Increase the base width
- 2. Slope the base of the structure
- 3. Lower the wall base
- 4. Add a key

```
******************* Output Results **************
Date: **/11/23
                                           Time: 10.48.50
Flood Wall Stability Analysis Using CTWALL
Filename: I4CLPILE.DAT
Company name:
 CDM
Project name:
 TRWD-FWCC
Project location:
 Fort Worth, TX / Tarrant Regional Water District
Wall location:
 Training Walls
Computed by: WCS
** Overturning Results **
*******
Solution converged in 1 iterations.
SMF used to calculate K's = .6667
Alpha for the SMF = -44.6301
Calculated earth pressure coefficients:
 Driving side at rest K = .4912
 Driving side at rest Kc = 1.1308
Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
  Full passive K calculated for resisting side.
  50% of full passive will be used.
Depth of cracking = .00 ft
** Driving side pressures **
 Water pressures:
   Elevation Pressure
     (ft)
               (ksf)
   _____
      530.00 .0000
      508.00
                 .7451
 Earth pressures:
   Elevation Pressure
     (ft)
              (ksf)
   ______
      536.04 .0000
      530.00 .4480
515.18 1.5189
508.00 1.8580
```

Surcharge pressures:

Press.
(ksf)
=======
.049
.049

** Resisting side pressures **

Water pressur	res:
Elevation	Pressure
(ft)	(ksf)
========	========
508.01	.0000
508.00	.0006
508.00	.0006

** Uplift pressures **

Water pressures: x-coord. Pre

x-coord.	Pressure
(ft)	(ksf)
========	=========
.00	.7451
26.00	.0006

=======================================	========	==========		========
Part			Mom. Arm	Moment
	Vert.	Horiz.	(ft)	(ft-k)
=======================================	=======	========		========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:				
Moist soil	5.475		-19.96	-109.27
Saturated soil	39.889		-17.47	-696.70
Water above structure	.000		.00	.00
Water above soil	.000		.00	.00
External vertical loads	1.850		-16.75	-30.99
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:				
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure	.000		.00	.00
Water above soil	.000		.00	.00
Driving side:				
Effective earth loads		28.052	9.54	267.64
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		1.377	14.02	19.31
Water loads		8.196	7.33	60.10
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		.000	95	.00
Foundation:				
Vertical force on base			-9.53	
Shear on base		-37.625		
-			-17.33	167.96
			=========	========
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 61.988 kips
Shear force on base = 37.625 kips
Max. available shear force = 34.185 kips

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

Base pressure at heel = .4771 ksf Base pressure at toe = 4.2912 ksf

Xr (measured from toe) = 9.53 ft
Resultant ratio = .3667
Stem ratio = .2308
Base in compression = 100.00 %
Overturning ratio = 2.15

Volume of concrete = 6.04 cubic yds/ft of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

```
*******
** Sliding Results **
*******
```

Solution converged. Summation of forces = 0.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	(kips)	(kips)
=======		
1	.000	3.378
2	.000	1.850
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge	press.	press.	x-coord.	press.
number	(ksf)	(ksf)	(ft)	(ksf)
=======	========	=======	========	=======
1	.0000	.7451		
2			.0000	.7451
2			26.0000	.0006
3	.0000	.0000		

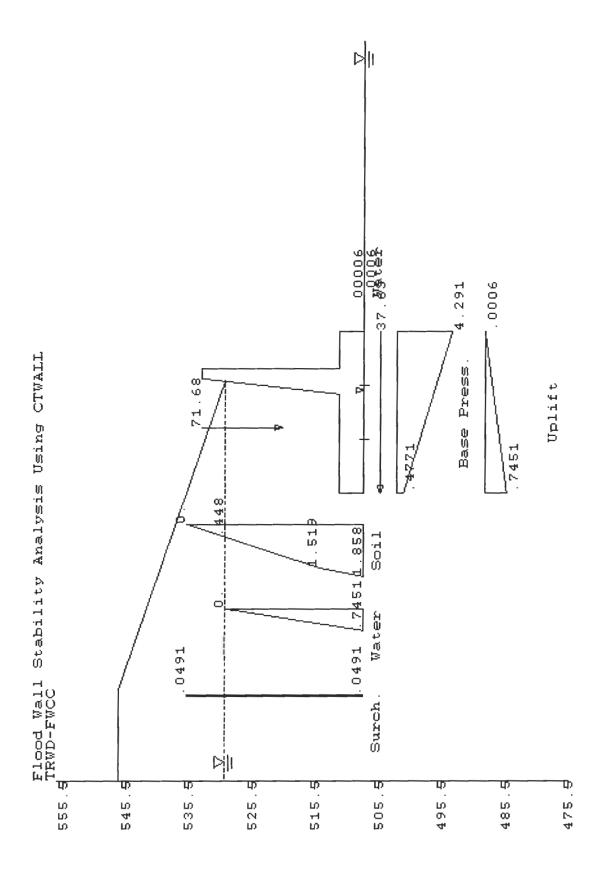
Points of sliding plane: Point 1 (left), x = .00 ft, y = .00 ft Point 2 (right), x = .26.00 ft, y = .00 ft

Depth of cracking = .00 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
======		=======	========	========	========
1	-48.867	51.351	54.698	29.209	10.882
2	.000	26.000	69.832	26.000	9.694
3	.000	.000	.000	.000	.000

Wedge number	Net force (kips)
=======	=========
1	-30.964
2	30.964
3	.000
=======	========
SUM =	.000

| Factor of safety = | 1.104 | +-----+



```
****** Echoprint of Input Data ***********
Date: **/11/23
                                                                  Time: 11.03.16
Flood Wall Stability Analysis Using CTWALL
Filename: I4CSPILE.DAT
Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Training Walls
Computed by: WCS
Structural geometry data:
  Elevation of top of stem (ELTS) = 533.50 \text{ ft}
  Height of stem (HTS)
                                                        = 21.50 ft
  Thickness bottom of stem (TTS) = 1.50 ft
Thickness bottom of stem (TBS) = 4.00 ft
Dist. of batter at bot. of stem (TBSR) = .00 ft
Depth of heel (THEEL) = 4.00 ft
Distance of batter for heel (RTRH)
                                                                .00 ft
4.00 ft
  Depth of toe (TTOE)
                                                         =
                                                                 6.00 ft
.00 ft
  Width of toe (TWIDTH)
                                                         =
  Distance of batter for toe (BTRT) = .00 ft
Width of base (BWIDTH) = 26.00 ft
Depth of key (HK) = .00 ft
Width of bottom of key (TK) = .00 ft
Dist. of batter at bot. of key (BTRK) = .00 ft
```

Structure coordinates:

x (ft)	y (ft)
========	=======
.00	508.00
.00	512.00
16.00	512.00
18.50	533.50
20.00	533.50
20.00	512.00
26.00	512.00
26.00	508.00

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:
Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.
Phi	C	Unit wt.	unit wt.	Delta	soil
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)
========	========	========	=======	======	======
.00	1.000	.100	.130	.00	530.01

Driving side soil geometry:

Soil	Batter	Distance
point	(in:1ft)	(ft)
======	========	========
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soil	x	У
point	(ft)	(ft)
=====	=========	========
1	-1081.91	546.68
2	-31.91	546.68
3	18.09	530.01

Resisting side soil property data:

		Moist	Saturated	Elev.	
Phi	C	Unit wt.	unit wt.	soil	Batter
(deg)	(ksf)	(kcf)	(kcf)	(ft)	(in:1ft)
========	========	========			=======
.00	1.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	x	У
point	(ft)	(ft)
=====	=========	=========
1	26.00	508.00
2	526.00	508.00

Foundation property data:

```
phi for soil-structure interface = .00 (deg)
c for soil-structure interface = 1.000 (ksf)
phi for soil-soil interface = .00 (deg)
c for soil-soil interface = 1.000 (ksf)
```

Water data:

Driving side elevation = 530.00 ft Resisting side elevation = 508.01 ft Unit weight of water = .0625 kcf Seepage pressures computed by Line of Creep method.

Uniform load data: Magnitude of load = .10 k/ft Minimum required factors of safety:

Sliding FS = 1.33Overturning = 75.00% base in compression

Crack options:

o Crack *is* down to bottom of heel

o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

**** Summary of Results ****

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

* Overturning * Required base in comp. = 75.00 % ************* Actual base in comp. = 100.00 % Overturning ratio = 5.26

Xr (measured from toe) = 13.05 ft Resultant ratio = .5020 Stem ratio = .2308

Base pressure at heel = 2.9973 ksfBase pressure at toe = 2.9277 ksf

To increase stability try one or a combination of the following:

- 1. Increase the base width
- 2. Slope the base of the structure
- 3. Lower the wall base
- 4. Add a key

```
************************ Output Results ***************
Date: **/11/23
                                            Time: 11.03.16
Flood Wall Stability Analysis Using CTWALL
Filename: I4CSPILE.DAT
Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
 Training Walls
Computed by: WCS
********
** Overturning Results **
*******
Solution converged in 1 iterations.
SMF used to calculate K's =
                             .6667
Alpha for the SMF = -31.6073
Calculated earth pressure coefficients:
 Driving side at rest K = 1.0000
 Driving side at rest Kc = 2.4441
 Resisting side at rest K =
 Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
 Full passive K calculated for resisting side.
  50% of full passive will be used.
Depth of cracking =
                      14.94 ft
Crack extends to bottom of base of structure.
** Driving side pressures **
 Water pressures:
   Elevation Pressure
      (ft)
               (ksf)
   _____
      536.04 .0000
521.11 .9335
508.00 .7879
 Earth pressures:
   Elevation Pressure
```

(ksf)

 536.04
 .0000

 521.11
 .0000

 508.00
 .8795

Surcharge pressures: Elev. Press. (ft) (ksf) 521.11 .100 508.00 .100

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)		
========	========		
508.01	.0000		
508.00	.0006		
508.00	3770		

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
=========	========
.00	.7879
26.00	3770

	========	========	========	========
Part	Force	(kips)	Mom. Arm	Moment
	Vert.	Horiz.	(ft)	(ft-k)
	========	========	=========	========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:				
Moist soil			-19.96	-109.27
Saturated soil			-17.47	-696.70
Water above structure			.00	.00
Water above soil	.000		.00	.00
External vertical loads	1.850		-16.75	-30.99
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:				
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure			.00	.00
Water above soil	.000		.00	.00
Driving side:				
Effective earth loads		5.763	4.37	25.17
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		1.311	6.55	8.59
Water loads		18.251	11.07	202.07
Resisting side:				
Effective earth loads		.000		.00
Water loads		.000	-508.00	.00
Foundation:				
Vertical force on base			-13.05	
Shear on base Uplift		-25.325		
Uplitt	5.342		-25.28	-135.06
## OF - F 1 OF I - ## OTBIC	========		========	========
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 77.024 kips
Shear force on base = 25.325 kips
Max. available shear force = 26.000 kips

Base pressure at heel = 2.9973 ksfBase pressure at toe = 2.9277 ksf

Xr (measured from toe) = 13.05 ft
Resultant ratio = .5020
Stem ratio = .2308
Base in compression = 100.00 %
Overturning ratio = 5.26

Volume of concrete = 6.04 cubic yds/ft of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

Solution converged. Summation of forces = 0.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	(kips)	(kips)
======		=========
1	.000	.000
2	24.573	1.850
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge number	press. (ksf)	press. (ksf)	x-coord. (ft)	press. (ksf)
========	=======	========	=========	========
1	.0000	.0000		
2			.0000	1.3750
2			26.0000	3770
3	.0000	.0000		

Points of sliding plane:

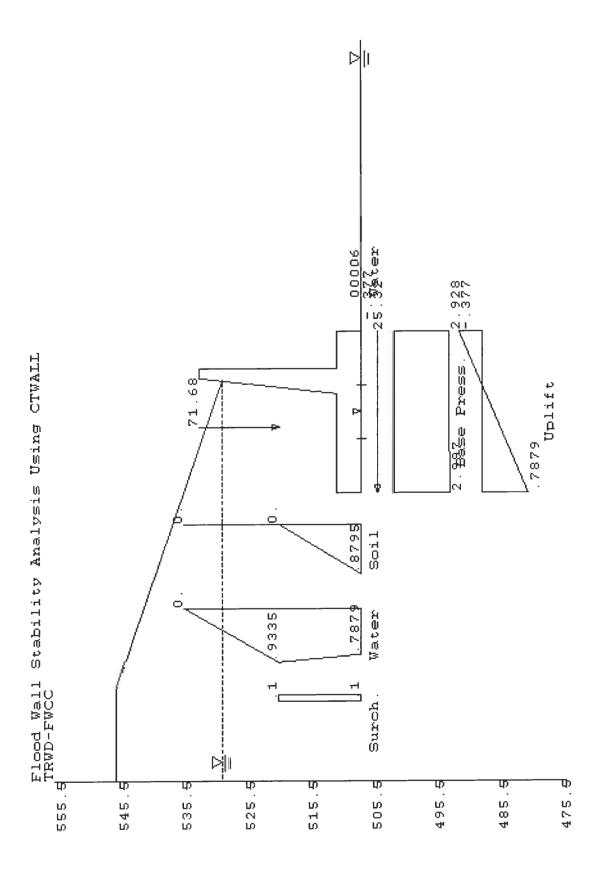
Point 1 (left), x = .00 ft, y = 508.00 ftPoint 2 (right), x = 26.00 ft, y = 508.00 ft

Depth of cracking = 28.04 ft Crack extends to bottom of base of structure.

	Failure	Total	Weight	Submerged	Uplift
Wedge	angle	length	of wedge	length	force
number	(deg)	(ft)	(kips)	(ft)	(kips)
======	========	=======	========	========	=======
1	.000	.000	.000	.000	.000
2	.000	26.000	69.832	26.000	12.974
3	.000	.000	.000	.000	.000

Wedge	Net force
number	(kips)
=======	=======
1	.000
2	.000
3	.000
========	========
SUM =	.000

```
| Factor of safety = 1.058 | +-----
```



****** Data ****** Echoprint of Input Data ************* Date: **/01/17 Time: 10.59.43 Flood Wall Stability Analysis Using CTWALL Filename: I1FLPILE.DAT Company name: CDMProject name: TRWD-FWCC Project location: Fort Worth, TX / Tarrant Regional Water District Wall location: Training Walls Computed by: WCS Structural geometry data: Elevation of top of stem (ELTS) = 533.50 ft Height of stem (HTS) = 21.50 ft Height of stem (HTS) = 21.50 ft
Thickness top of stem (TTS) = 1.50 ft
Thickness bottom of stem (TBS) = 4.00 ft
Dist. of batter at bot. of stem (TBSR) = .00 ft
Depth of heel (THEEL) = 4.00 ft
Distance of batter for heel (BTRH) = .00 ft
Depth of toe (TTOE) = 4.00 ft
Width of toe (TWIDTH) = 6.00 ft
Distance of batter for toe (BTRT) = .00 ft
Width of base (BWIDTH) = 26.00 ft
Depth of key (HK) = .00 ft
Width of bottom of key (TK) = .00 ft
Dist. of batter at bot. of key (BTRK) = .00 ft

Structure coordinates:

x (ft)	y (ft)
=======	=======
.00	508.00
.00	512.00
16.00	512.00
18.50	533.50
20.00	533.50
20.00	512.00
26.00	512.00
26.00	508.00

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:
Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.	
Phi	С	Unit wt.	unit wt.	Delta	soil	
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)	
========	=======	========		======	======	
27.00	.000	.100	.130	.00	530.01	

Driving side soil geometry:

Soil	Batter	Distance
point	(in:1ft)	(ft)
======	==========	=======
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soi	.1	x	У	
poi	nt	(ft)	(ft)	
===	======		========	===
1	- 1	.081.91	546.68	
2		~31.91	546.68	
3		18.09	530.01	

Resisting side soil property data:

-1.1			Saturated		
Phi	C	Unit wt.	unit wt.	soil	Batter
(deg)	(ksf)	(kcf)	(kcf)	(ft)	(in:1ft)
========	========	========	========		=======
27.00	.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	x	У
point	(ft)	(ft)
=======	========	=========
1	26.00	508.00
2	526.00	508.00

Foundation property data:

phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .100 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .100 (ksf)

Water data:

Driving side elevation = 530.00 ft
Resisting side elevation = 519.00 ft
Unit weight of water = .0625 kcf

Seepage pressures computed by Line of Creep method.

Minimum required factors of safety:

Sliding $\overline{FS} = 1.50$

Overturning = 100.00% base in compression

Crack options:

o Crack depth is to be calculated

o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

**** Summary of Results ****

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

* Overturning * Required base in comp. = 100.00 %

Actual base in comp. = 100.00 %
Overturning ratio = 1.67

Xr (measured from toe) = 8.82 ft
Resultant ratio = .3392
Stem ratio = .2308

Base pressure at heel = .0670 ksfBase pressure at toe = 3.7592 ksf

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

```
********

* Sliding * Min. Required = 1.50

*******

Actual FS = 1.05
```

To increase stability try one or a combination of the following:

- 1. Increase the base width
- 2. Slope the base of the structure
- 3. Lower the wall base
- 4. Add a key

```
**************** Output Results **************
Date: **/01/17
                                           Time: 10.59.43
Flood Wall Stability Analysis Using CTWALL
Filename: I1FLPILE.DAT
Company name:
  CDM
Project name:
 TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Training Walls
Computed by: WCS
*******
** Overturning Results **
********
Solution converged in 1 iterations.
SMF used to calculate K's = .6667
Alpha for the SMF = -43.8621
Calculated earth pressure coefficients:
 Driving side at rest K = .4874
Driving side at rest Kc = 1.1551
 Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
 Full passive K calculated for resisting side.
 50% of full passive will be used.
Depth of cracking =
** Driving side pressures **
 Water pressures:
   Elevation Pressure
                (ksf)
   ______
      530.00 .0000
      508.00
                1.0599
 Earth pressures:
   Elevation Pressure
                (ksf)
   _____
      536.04 .0000
      530.00
                .4509
      516.01 1.3707
508.00 1.6903
```

^{**} Resisting side pressures **

Water pressures:

Pressure (ksf)
=======
.0000
.6875
.6875

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
========	=========
.00	1.0599
26.00	.6875

** Forces and moments **

		:========	=========	
Part	Force Vert.	(kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
	veit.	10112.	(10)	(10-K)
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:	24.409		-11.00	-209.03
Moist soil	5.475		-19.96	-109.27
Saturated soil	39.889		-17.47	-696.70
Water above structure	.000		.00	.00
Water above soil	.000		.00	.00
External vertical loads	.000		.00	.00
Ext. horz. pressure loads	.000	.000	.00	.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:		, , ,		
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure	.000		.00	.00
Water above soil	2.625		-3.00	-7.88
Driving side:				
Effective earth loads		26.365	9.72	256.31
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		.000	.00	.00
Water loads		11.659	7.33	85.51
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		-3.781	3.67	-13.87
Foundation:				
Vertical force on base			-8.82	438.64
Shear on base		-34.243	.00	.00
Uplift	-22.716		-13.92	316.29
			=========	========
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 49.741 kips
Shear force on base = 34.243 kips
Max. available shear force = 27.944 kips

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

Base pressure at heel = .0670 ksfBase pressure at toe = 3.7592 ksf

Xr (measured from toe) = 8.82 ft
Resultant ratio = .3392
Stem ratio = .2308
Base in compression = 100.00 %
Overturning ratio = 1.67

Volume of concrete = 6.04 cubic yds/ft of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

******* ** Sliding Results ** *******

Solution converged. Summation of forces = 0.

	Horizontal	Vertical	
Wedge	Loads	Loads	
Number	(kips)	(kips)	
=======			
1	.000	.000	
2	-3.781	2.625	
3	.000	.000	

Water pressures on wedges:

	Top	Bottom		
Wedge number	press. (ksf)	press. (ksf)	x-coord. (ft)	press. (ksf)
=======		========	========	========
1	.0000	1.0599		
2			.0000	1.0599
2			26.0000	.6875
3	.0000	.0000		

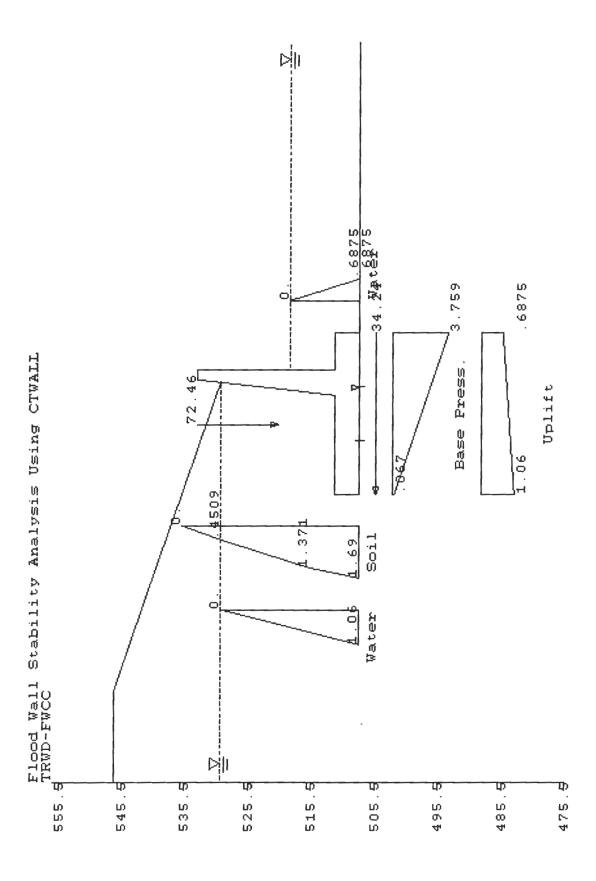
Points of sliding plane: Point 1 (left), x = .00 ft, y = 508.00 ft Point 2 (right), x = 26.00 ft, y = 508.00 ft

Depth of cracking = .00 ft

	Failure	Total	Weight	Submerged	Uplift
Wedge	angle	length	of wedge	length	force
number	(deg)	(ft)	(kips)	(ft)	(kips)
======		=======	========	=======	========
1	-48.938	51.296	54.519	29.178	15.463
2	.000	26.000	69.832	26.000	22.716
3	.000	.000	.000	.000	.000

Wedge number	Net force (kips)
======	=========
1	-30.475
2	30.475
3	.000
======	
SUM	000.

```
+----+
| Factor of safety = | 1.047 | |
```



****** Echoprint of Input Data ***********

Date: **/01/17 Time: 10.57.07

Flood Wall Stability Analysis Using CTWALL

Filename: I1FSPILE.DAT

Company name:

CDM

Project name:

TRWD-FWCC

Project location:

Fort Worth, TX / Tarrant Regional Water District

Wall location: Training Walls Computed by: WCS

Structural geometry data:

Elevation of top of stem (ELTS)	=	533.50	ft
Height of stem (HTS)	=	21.50	ft
Thickness top of stem (TTS)	=	1.50	ft
Thickness bottom of stem (TBS)	=	4.00	ft
Dist. of batter at bot. of stem (TBSR) =	.00	ft
Depth of heel (THEEL)	=	4.00	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	4.00	ft
Width of toe (TWIDTH)	=	6.00	ft
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	26.00	fτ
Depth of key (HK)	=	.00	ft
Width of bottom of key (TK)	=	.00	ft
Dist. of batter at bot. of key (BTRK)	=	.00	ft

Structure coordinates:

x (ft)	y (ft)
========	======
.00	508.00
.00	512.00
16.00	512.00
18.50	533.50
20.00	533.50
20.00	512.00
26.00	512.00
26.00	508.00

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:

Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.
Phi	C	Unit wt.	unit wt.	Delta	soil
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)
=========	========	========		===== =	======
.00	1.000	.100	.130	.00	530.01

Driving side soil geometry:

Soil	Batter	Distance
point	(in:1ft)	(ft)
=====	==========	=======
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soil	x	У	
point	(ft)	(ft)	
======		=========	=
1	-1081.91	546.68	
2	-31.91	546.68	
3	18.09	530.01	

Resisting side soil property data:

		Moist	Saturated	Elev.	
Phi	C	Unit wt.	unit wt.	soil	Batter
(deg)	(ksf)	(kcf)	(kcf)	(ft)	(in:1ft)
========	========	========	========	=======	=======
.00	2.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	X	У
point	(ft)	(ft)
======	=========	=============
1	26.00	508.00
2	526.00	508.00

Foundation property data:

phi for soil-structure interface = .00 (deg)
c for soil-structure interface = 1.000 (ksf)
phi for soil-soil interface = .00 (deg)
c for soil-soil interface = 1.000 (ksf)

Water data:

Driving side elevation = 530.00 ft

Resisting side elevation = 519.00 ft

Unit weight of water = .0625 kcf

Seepage pressures computed by Line of Creep method.

Minimum required factors of safety:

Sliding $\hat{F}S = 1.50$

Overturning = 100.00% base in compression

Crack options:

- o Crack *is* down to bottom of heel
- o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

***** Summary of Results *****

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

********** *** Satisfied ***

 $Xr mtext{(measured from toe)} = 11.12 mtext{ ft}$ Resultant ratio = .4276 Stem ratio = .2308

Base pressure at heel = 1.1996 ksfBase pressure at toe = 3.0423 ksf

To increase stability try one or a combination of the following:

- 1. Increase the base width
- 2. Slope the base of the structure
- 3. Lower the wall base
- 4. Add a key

```
******************** Output Results ***************
Date: **/01/17
                                            Time: 10.57.07
Flood Wall Stability Analysis Using CTWALL
Filename: I1FSPILE.DAT
Company name:
 CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Training Walls
Computed by: WCS
*******
** Overturning Results **
********
Solution converged in 1 iterations.
SMF used to calculate K's =
                             .6667
Alpha for the SMF = -30.8493
Calculated earth pressure coefficients:
 Driving side at rest K = 1.0000
 Driving side at rest Kc = 2.5701
 Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
  Full passive K calculated for resisting side.
  50% of full passive will be used.
Depth of cracking =
                      28.04 ft
Crack extends to bottom of base of structure.
** Driving side pressures **
 Water pressures:
   Elevation Pressure
      (ft)
               (ksf)
   _____
      536.04 .0000
520.90 .9465
508.00 1.0218
  Earth pressures:
   Elevation Pressure
```

** Resisting side pressures **

536.04 .0000

520.90 508.00

(ksf)

.0000

.3283

Water pressures:

Elevation	Pressure
(ft)	(ksf)
========	=========
519.00	.0000
508.00	.6875
508.00	3099

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
=========	========
.00	1.0218
26.00	.3099

** Forces and moments **

	=======	========	=======================================	========
Part	Force Vert.	(kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
	========	=========		========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:				
Moist soil	5.475		-19.96	-109.27
Saturated soil	39.889		-17.47	-696.70
Water above structure	.000		.00	.00
Water above soil	.000		.00	.00
External vertical loads	.000		.00	.00
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:				
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure	.000		.00	.00
Water above soil	2.625		-3.00	-7.88
Driving side:				
Effective earth loads		2.117	4.30	9.10
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		.000	.00	.00
Water loads		19.860	10.54	209.41
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		-3.781	3.67	-13.87
Foundation:				
Vertical force on base			-11.12	613.08
Shear on base		-18.196	.00	.00
Uplift	-17.313		-15.32	265.17
=======================================	========	========	=========	========
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 55.145 kips
Shear force on base = 18.196 kips
Max. available shear force = 26.000 kips

Base pressure at heel = 1.1996 ksfBase pressure at toe = 3.0423 ksf

Xr (measured from toe) = 11.12 ft
Resultant ratio = .4276
Stem ratio = .2308
Base in compression = 100.00 %
Overturning ratio = 2.27

Volume of concrete = 6.04 cubic yds/ft of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

******* ** Sliding Results ** *******

Solution converged. Summation of forces = 0.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	per (kips) (kips)	
=======	.=========	=======================================
1	.000	.000
2	20.791	2.625
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge number	press. (ksf)	press. (ksf)	x-coord. (ft)	press. (ksf)
number	(KSI)	(KSI)	(IL)	(KSI)
=======	=======	=======		
1	.0000	.0000		
2			.0000	1.3750
2			26.0000	.3099
3	.0000	.0000		

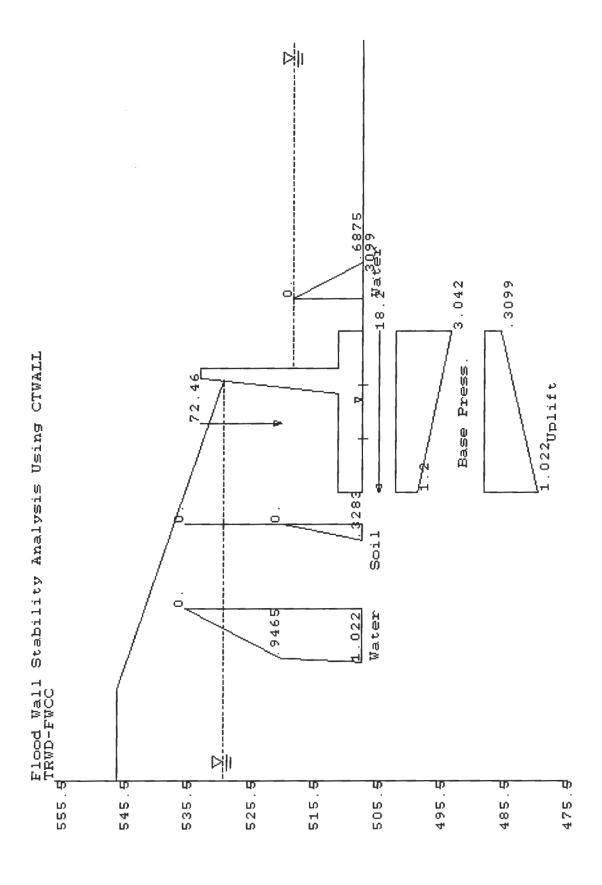
Points of sliding plane: Point 1 (left), x = .00 ft, y = 508.00 ft Point 2 (right), x = 26.00 ft, y = 508.00 ft

Depth of cracking = 28.04 ft Crack extends to bottom of base of structure.

	Failure	Total	Weight	Submerged	Uplift
Wedge	angle	length	of wedge	length	force
number	(deg)	(ft)	(kips)	(ft)	(kips)
======	========	=======	========	========	=======
1	.000	.000	.000	.000	.000
2	.000	26.000	69.832	26.000	21.904
3	.000	.000	.000	.000	.000

Wedge	Net force
number	(kips)
======	========
1	.000
2	.000
3	.000
======	========
SUM =	.000

```
+-----+
| Factor of safety = 1.251 |
+-----
```





CLIENT	TRWD	JOB NO.	42275	COMPUTED BY	Wes
PROJECT	FNCC	DATE CHECKED	V 1/8	DATE	1-7-05
DETAIL	TRAINING WALLS - GETSMIC	CHECKED BY		PAGE NO.	

SETS MIC ANALYSIS

USE
$$K_h = 0.05g$$

 $Y = tan^{-1}(K_h) = 2.86$
 $K_V = 8 = 0^{\circ}$
 $\beta = tan^{-1}(\frac{1}{3}) = 18.4^{\circ}$
 $K_{AE} = \frac{\cos^{2}(24.85^{\circ} - 2.86)}{(\cos 2.86)^{2} \left[1 + \sqrt{\frac{5m(24.85)(5m(24.85 - 2.86 - 18.4)}{\cos(18.4)}}\right]^{2}}$
 $= \frac{0.860}{0.918 \left[1.167\right]^{2}} = 0.633$
 5 TATIC:
 $K_A = \frac{\cos^{2}(24.85)}{(\cos(24.85)) \sin(24.85 - 18.4)}$
 $= \frac{1}{(\cos(24.85)) \sin(24.85 - 18.4)}$
 $= \frac{1}{(\cos(24.85)) \sin(24.85 - 18.4)}$
 $= \frac{1}{(\cos(24.85)) \cos(24.85 - 18.4)}$

AKAE = 0.633 - 0.550 = 0.083

where

$$K_{A} = \frac{\sin^{2}(\theta + \phi)\cos \delta}{\sin \theta \sin (\theta - \delta) \left[1 + \sqrt{\frac{\sin (\phi + \delta)\sin (\phi - \beta)}{\sin (\theta - \delta)\sin (\theta + \beta)}}\right]^{2}}$$
 [3-12]

Examples 1 and 2 in Appendix M and the examples in Appendix N demonstrate the use of Equation 3-12.

(2) When wall friction is neglected (δ = 0), Equation 3-12 reduces to:

$$K_{A} = \frac{\sin^{2}(\theta + \phi)}{\sin^{2}\theta \left[1 + \sqrt{\frac{\sin \phi \sin (\phi - \beta)}{\sin \theta \sin (\theta + \beta)}}\right]^{2}}$$
[3-13]

(3) For the case of is no wall friction $(\delta = 0)$ and a vertical wall $(\theta = 90 \text{ degrees})$,

$$K_{A} = \frac{\cos^{2} \phi}{\left[1 + \sqrt{\frac{\sin \phi \sin (\phi - \beta)}{\cos \beta}}\right]^{2}}$$
 [3-14]

(4) For the special case of no wall friction, horizontal backfill surface, and a vertical wall, Coulomb's equation for K_{Λ} reduces to:

$$K_{A} = \frac{1 - \sin \phi}{1 + \sin \phi} = \tan^{2} \left(45^{\circ} - \frac{\phi}{2}\right)$$
 [3-15]

which is identical to Rankine's equation for this special case.

(5) As stated in paragraph 3-11c and demonstrated in Figure 3-6 and Appendix E, a developed ϕ angle computed by Equation 3-10 using an SMF of 2/3 can be used in Coulomb's equation to compute an earth pressure coefficient close to that given by the Jaky or Danish Code equations.

EM 1110-2-2502 29 Sep 89

For driving (active) wedges (Figure 3-34a),

$$P_{AE} = \frac{1}{2} K_{AE} \gamma (1 - k_{v}) h^{2}$$
 [3-44]

$$K_{AE} = \frac{\cos^{2}(\phi - \Psi - \theta)}{\cos \Psi \cos^{2}\theta \cos (\Psi + \theta + \delta) \left[1 + \sqrt{\frac{\sin(\phi + \delta)\sin(\phi - \Psi - \beta)}{\cos(\beta - \theta)\cos(\Psi + \theta + \delta)}}\right]^{2}}$$
 [3-45]

For resisting (passive) wedges (Figure 3-34b),

$$P_{PE} = \frac{1}{2} K_{PE} \gamma (1 - k_v) h^2$$
 [3-46]

$$R_{PE} = \frac{1}{2} K_{PE} \gamma (1 - k_{V}) h^{2}$$

$$\cos^{2} (\phi - \Psi + \theta)$$

$$\cos^{2} \theta \cos(\Psi - \theta + \delta) \left[1 - \sqrt{\frac{\sin(\phi - \delta) \sin(\phi - \Psi + \beta)}{\cos(\beta - \theta) \cos(\Psi - \theta + \delta)}} \right]^{2} [3-47]$$

 P_{AE} and P_{PE} are the combined static and dynamic forces due to the driving and resisting wedges, respectively. The equations are subject to the same limitations that are applicable to Coulomb's equations. Definitions of terms are as follows:

 γ = unit weight of soil

k_{..} = vertical acceleration in g's

h = height of wall

o = internal friction angle of soil

$$\Psi = \tan^{-1} \left(\frac{k_h}{1 - k_v} \right) = \text{seismic inertia angle}$$

k, = horizontal acceleration in g's

 θ = inclination of wall with respect to vertical (this definition of θ is different from 6 in Coulomb's equations)

 δ = wall friction angle

1

 β = inclination of soil surface (upward slopes away from the wall are positive)

CLIENT	TRWD	JOB NO.	42275	COMPUTED BY	West
PROJECT	FWCC	DATE CHECKED		DATE	1-7-05
CETAIL	TRAINING WALLS - SEISMIC	CHECKED BY		PAGE NO.	

SETSMIC ANALYSIS:

CASE I 3EL PILE, DAT

INDUTIA OF CONC WALL PLUS SOIL ABOVE HEEL =
$$K_h W$$

$$W = 24.469 + (5.475 + 39.889) = 69.83^{K}$$

$$I_{cs} = 0.05(69.83) = 3.49^{K}$$

$$P_{AE} = P_{A} + P_{WS} + \Delta P_{AE}$$

$$= \frac{1}{2} k_{A} \delta_{b} h^{2} + \frac{1}{2} \delta_{w} h^{2} + \frac{1}{2} \Delta k_{AE} \delta h^{2}$$

$$= \frac{1}{2} (0.550) \left(\frac{150 - 62.5}{1000} \right) (25.5)^{2} + \frac{1}{2} (0.0625) (25.5)^{2}$$

$$+ \frac{1}{2} (0.083) (0.130) (25.5)^{2}$$

$$= 12.07 + 20.32 + 3.51 = 35.9 \text{ M}$$

$$P_{A} \qquad P_{AE} \qquad \Delta P_{AE}$$

DRIVING WEDGE NET FACE FROM CTUALL (F.S.=1.10): 32.529 K

NET ADDL FORCE = 35,9+3,49 - 32,53 = 6,86 K

PA+Pus = 12,07+20.32 = 32.39 K

ABE = 3.51 K

TOTAL SEISMIK MOMENT:

$$M_s = (32.34^{k})(\frac{25.5}{2.5}) + (3.51^{k})(0.67 \times 25.5') + (3.49^{k})(\frac{25.5'}{2.5})$$
 $= 3.79.8^{1k}$
 $= 3.79.8 - (250.95 + 97.73) = 31.52^{1k}$
 $h_e = \frac{31.52^{1k}}{3.51^{1k}} = 9.0'$
 $\therefore APPLY 3.51^{1k} C 9.0' ABOVE BASE = EL 517.0'$

CONCLUSION: SEISMIC DRIVING FORCE & MAX. STATIC LATERAL FARIE
-- SEISMIC DOES NOT CONTROL

Water pressures:

(ft) (ksf) 524.30 .0000 508.00 1.0187 508.00 1.0187

Elevation Pressure (fr) (1765) W/O ADDED SURTHARKE LINE LAD

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
=========	=======
.00	1.2117
26.00	1.0187

** Forces and moments **

=======================================	.=======	=========	=========	========
Part	Force	(kips)	Mom. Arm	Moment
	Vert.	Horiz.	(ft)	(ft-k)
	========	========	=======================================	========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:				
Moist soil			-19.96	-109.27
Saturated soil			-17.47	-696.70
Water above structure			.00	.00
Water above soil			.00	
External vertical loads			.00	.00
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:				
Moist soil			.00	.00
Saturated soil			.00	.00
Water above structure			.00	.00
Water above soil	4.612		-3.00	-13.84
Driving side:				
Effective earth loads		25.552	9.81	250.55
Shear (due to delta)			.00	.00
Horiz. surcharge effects		.000	.00	.00
Water loads		13.329	7.33	97.73
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		-8.303	5.43	-45.12
Foundation:	.=			
Vertical force on base			-8.75	
Shear on base		-30.578	.00	.00
Uplift			-13.37	387.82
			=========	=======
** Statics Check ** SUMS =	.000	.000		.00

******* ** Sliding Results ** ******

Stationary solution. Static sum of forces.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	(kips)	(kips)
=======	=========	
1	.000	.000
2	-8.303	4.612
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge	press.	press.	x-coord.	press.
number	(ksf)	(ksf)	(ft)	(ksf)
=======		========	========	========
1	.0000	1.2117		
2			.0000	1.2117
2			26.0000	1.0187
3	.0000	.0000		

Points of sliding plane: Point 1 (left), x = .00 ft, y = .00 ft Point 2 (right), x = .00 ft, y = .00 ft

Depth of cracking = .00 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1 2 3	-47.996	52.048	56.926	29.606	17.937
	.000	26.000	69.832	26.000	28.996
	.000	.000	.000	.000	.000

```
Wedge Net force number (kips)
______
   \begin{array}{ccc}
\frac{1}{2} & -32.529 \\
2 & 31.719 \\
3 & .000
\end{array}
SUM = -.811
```

NOTE: Forces are calculated for the FS specified below.

```
| Factor of safety = 1.100 |
```

```
****** Data ****** Echoprint of Input Data *************
Date: **/01/07
                                                                                     Time: 11.51.38
Flood Wall Stability Analysis Using CTWALL
Filename: I3ELPILE.DAT
                                                                           WI SEISMIC SURCHARGE LINE LOAD
Company name:
    CDM
Project name:
    TRWD-FWCC
Project location:
    Fort Worth, TX / Tarrant Regional Water District
Wall location:
   Training Walls
Computed by: WCS
Structural geometry data:
   Elevation of top of stem (ELTS) = 533.50 ft
  Elevation of top of stem (ELTS) = 533.50 ft
Height of stem (HTS) = 21.50 ft
Thickness top of stem (TTS) = 1.50 ft
Thickness bottom of stem (TBS) = 4.00 ft
Dist. of batter at bot. of stem (TBSR) = .00 ft
Depth of heel (THEEL) = 4.00 ft
Distance of batter for heel (BTRH) = .00 ft
Width of toe (TTOE) = 4.00 ft
Distance of batter for toe (BTRT) = .00 ft
Width of base (BWIDTH) = 6.00 ft
Depth of key (HK) = .00 ft
Width of bottom of key (TK) = .00 ft
Dist. of batter at bot. of key (BTRK) = .00 ft
Structure coordinates:
     x (ft) y (ft)
    .00 508.00
         .00 508.00
.00 512.00
16.00 512.00
18.50 533.50
20.00 533.50
20.00 512.00
26.00 508.00
```

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:
Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.	
Phi	С	Unit wt.	unit wt.	Delta	soil	
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)	
========	=======	========	=======	======	======	
27.00	.000	.100	.130	.00	530.01	

Driving side soil geometry:

Soil point	Batter (in:1ft)	Distance (ft)
======		========
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soil	х	У
point	(ft)	(ft)
=====	========	
1	-1081.91	546.68
2	-31.91	546.68
3	18.09	530.01

Resisting side soil property data:

Phi (deg)	c (ksf)		Saturated unit wt. (kcf)		Batter (in:1ft)
========	=	========		======	=======
27.00	.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	X	У	
point	(ft.)	(ft)	
======	========	========	==
1	26.00	508.00	
2	526.00	508.00	

Foundation property data:

phi for soil-structure interface = 27.00 (deg) c for soil-structure interface = .100 (ksf) phi for soil-soil interface = 27.00 (deg) c for soil-scil interface = .100 (ksf)

Water data:

Driving side elevation = 530.00 ft
Resisting side elevation = 524.30 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

Horizontal line load data:

Elevation Force (ft) (kips) ______ 517.00 3.51

Minimum required factors of safety:

Sliding FS = 1.10 Overturning = 1.10 base in compression

Crack options:

o Crack depth is to be calculated

o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

Forces for sliding are calculated for the REQUIRED FS.

```
***** Summary of Results *****
```

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

* Overturning * Required base in comp. = .10 % ************ Actual base in comp. = 80.66 % Overturning ratio = 1.35

 $Xr mtext{(measured from toe)} = 6.99 mtext{ ft}$ Resultant ratio = .2689 Stem ratio = .2308

Base pressure at x= 20.97 ft from toe = .0000 ksf Base pressure at toe = 4.0466 ksf

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

```
****************** Output Results **************
Date: **/01/07
                                          Time: 11.51.38
Flood Wall Stability Analysis Using CTWALL
Filename: I3ELPILE.DAT
Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Training Walls
Computed by: WCS
*******
** Overturning Results **
********
Solution converged in 5 iterations.
SMF used to calculate K's = .6667
Alpha for the SMF
                  = -43.5082
Calculated earth pressure coefficients:
 Driving side at rest K = .4856
 Driving side at rest Kc =
                            1.1670
 Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
 Full passive K calculated for resisting side.
  50% of full passive will be used.
Depth of cracking =
                  .00 ft
** Driving side pressures **
 Water pressures:
   Elevation Pressure
     (ft)
              (ksf)
   _____
      530.00 .0000
      508.00 1.3750
 Earth pressures:
   Elevation Pressure
     (ft)
                (ksf)
   536.04.0000530.00.4521516.391.3464508.001.6773
```

^{**} Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
=========	========
524.30	.0000
508.00	1.0187
508.00	1.0187

** Uplift pressures **

Water pressures:

x-coord.	Pressure		
(ft)	(ksf)		
	=========		
.00	1.3750		
5.03	1.3750		
26.00	1.0187		

** Forces and moments **

	========		=======================================	========
Part	Force	(kips)	Mom. Arm	Moment
ļ	Vert.	Horiz.	(ft)	(ft-k)
	=======	========	:=======:::	========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:				
Moist soil			-19.96	-109.27
Saturated soil			-17.47	-696.70
Water above structure			.00	.00
Water above soil			.00	.00
External vertical loads			.00	.00
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		3.510	9.00	31.59
Structure, resisting side:				
Moist soil			.00	.00
Saturated soil			.00	.00
Water above structure			.00	.00
Water above soil	4.612		-3.00	-13.84
Driving side:				
Effective earth loads		26.290	9.75	256.22
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		.000	.00	.00
Water loads		15.125	7.33	110.92
Resisting side:		0.00		
Effective earth loads		.000	.00	.00
Water loads		-8.303	5.43	-45.12
Foundation:	40 421		5 00	0.0.55
Vertical force on base		26.600	-6.99	296.61
Shear on base Uplift	20 014	-36.622	.00	.00
ODIIIT	-32.014		-13.70	438.63
** Statics Check ** SUMS =	.000	.000		.00
Bederes effect Bold -	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 42.431 kips
Shear force on base = 36.622 kips
Max. available shear force = 23.717 kips

*** Warning *** The maximum available shear along the base of the structure has been exceeded!

Base pressure at x= 20.97 ft from toe = .0000 ksf Base pressure at toe = 4.0466 ksf

Xr (measured from toe) = 6.99 ft
Resultant ratio = .2689
Stem ratio = .2308
Base in compression = 80.66 %
Overturning ratio = 1.35

Volume of concrete = 6.04 cubic yds/ft of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

******* ** Sliding Results ** ******

Stationary solution. Static sum of forces.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	(kips)	(kips)
=======	==========	=========
1	.000	.000
2	-4.793	4.612
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	1.3750		
2			.0000	1.3750
2			5.0264	1.3750
2			26.0000	1.0187
3	.0000	.0000		

Points of sliding plane: Point 1 (left), x = .00 ft, y = 508.00 ft Point 2 (right), x = 26.00 ft, y = 508.00 ft

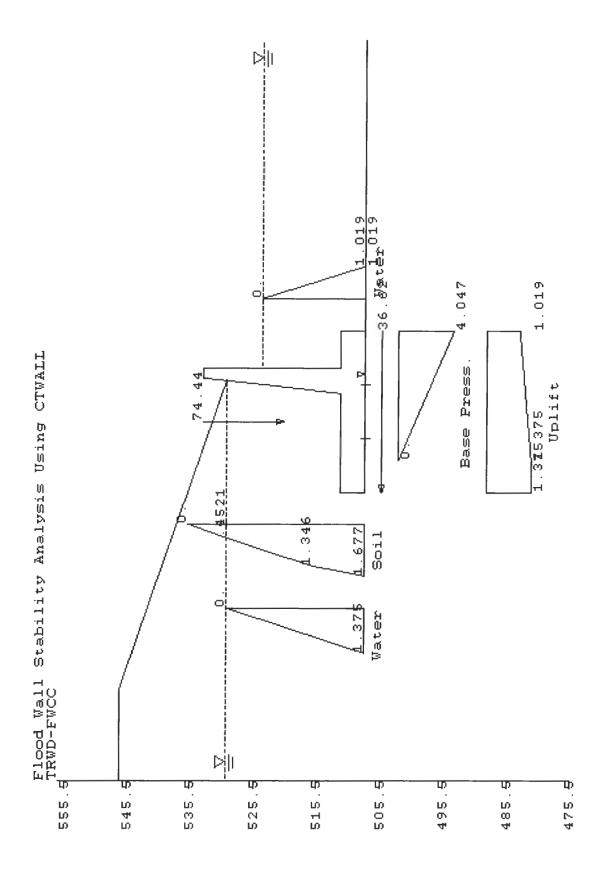
Depth of cracking = .00 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	-47.777	52.228	57.497	29.708	20.425
2	.000	26.000	69.832	26.000	32.014
3	.000	.000	.000	.000	.000

Wedge number	Net force (kips)			
=======	========			1 = K ROM GOATIC ANALYSES
1	-33.635	> DRIVING	FOR CE	< 37.6 1/1 PER STATIC ANALYSES
2	26.353			: SEISMIC DOES NOT
3	.000			LENTRUL
=======	=========			LININOL
SUM =	-7.282			

NOTE: Forces are calculated for the FS specified below.

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+---+
| Factor of safety = | 1.100 | +----+
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CLiENT	TRWD	JOB NO.	42275	COMPUTED BY	res
PFOJECT	FWCC	DATE CHECKED		DATE	1-7-05
DETAIL	TRAINING WALLS - SEISM	CHECKED BY		PAGE NO.	

CASE IBESPILE, DAT

- FULL CRACK TO BASE OF FOOTING

- SO NEGLECT "DYNAMIC CARRTH PRESSURE" & JUST INCLUDE
LATERAL INFRITA OF WALL + SOIL ABOVE PTG

$$W = 24.469 + (5.475 + 39.889) = 69.83^{k}$$

$$I_{CS} = 0.65 (69.83) = 3.49^{k}$$

$$\Rightarrow APPLY AT \frac{25.50'}{2} = 12.75', 5A1 13.0' ABOVE BASE$$

$$\Rightarrow EL 521.0$$

CONCLUSION= THIS CASE DOES NOT CONTROL DESIGN

Water pressures:

Elevation	Pressure
(ft)	(ksf)
=========	========
524.30	.0000
508.00	1.0187
508.00	.6412

==== CTWALL : I3ESPILE. DAT

W/O ADDED SURCHARGE LINE LOA)

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
=========	========
.00	1.1317
26.00	.6412

** Forces and moments **

	========		:========	========
Part		(kips) Horiz.		Moment (ft-k)
	.=======	=========	(10)	=========
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:				
Moist soil	5.475		-19.96	-109.27
Saturated soil			-17.47	-696.70
Water above structure			.00	.00
Water above soil	.000		.00	.00
External vertical loads	.000		.00	.00
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		.000	.00	.00
Structure, resisting side:				
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure	.000		.00	.00
Water above soil	4.612		-3.00	-13.84
Driving side:				
Effective earth loads		.909	4.30	3.91
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		.000	.00	.00
Water loads		20.568	10.33	212.47
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		-8.303	5.43	-45.11
Foundation:				
Vertical force on base			-11.49	590.35
Shear on base		-13.175	.00	.00
Uplift	-23.047		-14.20	327.24
** Statics Check ** SUMS =	.000	.000		.00

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*******
** Sliding Results **
*******
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Stationary solution. Static sum of forces.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	(kips)	(kips)
1	.000	.000
2	16.270	4.612
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge number	press. (ksf)	press. (ksf)	x-coord. (ft)	press. (ksf)
========	========	========	=========	=======
1	.0000	.0000		
2			.0000	1.3750
2			26.0000	.6412
3	.0000	.0000		

Points of sliding plane: Point 1 (left), x = 0.00 ft, y = 0.00 ft Point 2 (right), x = 0.00 ft, y = 0.00 ft

Depth of cracking = 28.04 ft Crack extends to bottom of base of structure.

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	.000	.000	.000	.000	.000
2	.000	26.000	69.832	26.000	26.210
3	.000	.000	.000	.000	.000

Wedge	Net force
number	(kips)
=========	_=======
1	.000
2	7.367
3	.000
========	========
SUM =	7.367

NOTE: Forces are calculated for the FS specified below.

```
| Factor of safety = | 1.100 |
```

```
****** Data ****** Echoprint of Input Data *************
Date: **/01/07
                                                                                    Time: 13.05.06
Flood Wall Stability Analysis Using CTWALL
Filename: I3ESPILE.DAT
                                                                           WI SEISIMIC SURLHARGE LINE
LOAD ADDED
Company name:
   CDM
Project name:
   TRWD-FWCC
Project location:
   Fort Worth, TX / Tarrant Regional Water District
Wall location:
   Training Walls
Computed by: WCS
Structural geometry data:
   Elevation of top of stem (ELTS) = 533.50 \text{ ft}
   Height of stem (HTS)
                                                                       = 21.50 ft
  Height of stem (HTS) = 21.50 ft
Thickness top of stem (TTS) = 1.50 ft
Thickness bottom of stem (TBS) = 4.00 ft
Dist. of batter at bot. of stem (TBSR) = .00 ft
Depth of heel (THEEL) = 4.00 ft
Distance of batter for heel (BTRH) = .00 ft
Width of toe (TWIDTH) = 6.00 ft
Distance of batter for toe (BTRT) = .00 ft
Width of base (BWIDTH) = 26.00 ft
Depth of key (HK) = .00 ft
Width of bottom of key (TK) = .00 ft
Dist. of batter at bot. of key (BTRK) = .00 ft
Structure coordinates:
    x (ft) y (ft)
   ______
        .00 508.00
.00 512.00
16.00 512.00
18.50 533.50
20.00 533.50
20.00 512.00
26.00 512.00
26.00 508.00
```

NOTE: X=0 is located at the left-hand side of the structure. The Y values correspond to the actual elevation used.

Structural property data:
Unit weight of concrete = .150 kcf

Driving side soil property data:

		Moist	Saturated		Elev.
Ph≟	C	Unit wt.	unit wt.	Delta	soil
(deg)	(ksf)	(kcf)	(kcf)	(deg)	(ft)
========	========	========	=======	======	=======
.00	1.000	.100	.130	.00	530.01

Driving side soil geometry:

Soil	Batter	Distance
point	(in:1ft)	(ft)
======	===========	
1	4.00	50.00
2	.00	50.00
3	.00	500.00

Driving side soil profile:

Soil	x	У	
point	(ft)	(ft)	
======		========	=
1	-1081.91	546.68	
2	-31.91	546.68	
3	18.09	530.01	

Resisting side soil property data:

		Moist	Saturated	Elev.	
Phi	С	Unit wt.	unit wt.	soil	Batter
(deg)	(ksf)	(kcf)	(kcf)	(ft)	(in:1ft)
========	=======		========		=======
.00	1.000	.100	.130	508.00	.00

Resisting side soil profile:

Soil	X	У
point	(ft)	(ft)
======	=========	=========
1	26.00	508.00
2	526.00	508.00

Foundation property data:

phi for soil-structure interface = .00 (deg)
c for soil-structure interface = 1.000 (ksf)
phi for soil-soil interface = .00 (deg)
c for soil-soil interface = 1.000 (ksf)

Water data:

Driving side elevation = 530.00 ft
Resisting side elevation = 524.30 ft
Unit weight of water = .0625 kcf

Seepage pressures computed by Line of Creep method.

Horizontal line load data:

Elevation Force (ft) (kips) 521.00 3.49

Minimum required factors of safety:

Sliding FS = 1.10Overturning = 1.0% base in compression

Crack options:

- o Crack *is* down to bottom of heel
- o Computed cracks *will* be filled with water

Strength mobilization factor = .6667

50% of full passive *is used* in the overturning analysis.

Forces on the resisting side *are used* in the sliding analysis.

Do iterate in overturning analysis.

Forces for sliding are calculated for the REQUIRED FS.

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***** Summary of Results *****
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Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

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*********

* Overturning * Required base in comp. = .10 %

*********

Actual base in comp. = 100.00 %

Overturning ratio = 1.93
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Xr (measured from toe) = 10.60 ft
Resultant ratio = .4078
Stem ratio = .2308

Base pressure at heel = .8834 ksfBase pressure at toe = 3.0703 ksf

* Sliding * Min. Required = 1.10

Actual FS = 1.10

Company name:

CDM

Project name: TRWD-FWCC

Project location:

Fort Worth, TX / Tarrant Regional Water District

Wall location: Training Walls Computed by: WCS

Solution converged in 1 iterations.

SMF used to calculate K's = .6667
Alpha for the SMF = -30.8493
Calculated earth pressure coefficients:
Driving side at rest K = 1.0000
Driving side at rest Kc = 2.5701
Resisting side at rest K = .0000
Resisting side at rest Kc = .0000
Full passive K calculated for resisting side.
50% of full passive will be used.

Depth of cracking = 28.04 ft Crack extends to bottom of base of structure.

** Driving side pressures **

Water pressures:

Elevation	Pressure
(ft)	(ksf)
========	=========
536.04	.0000
520.90	.9465
508.00	1.1317

Earth pressures:

Elevation	Pressure
(ft)	(ksf)
========	========
536.04	.0000
520.90	.0000
508.00	.1410

^{**} Resisting side pressures **

Water pressures:

Elevation	Pressure
(ft)	(ksf)
=========	=========
524.30	.0000
508.00	1.0187
508.00	.6412

** Uplift pressures **

Water pressures:

x-coord.	Pressure
(ft)	(ksf)
=========	========
.00	1.1317
26.00	.6412

** Forces and moments **

=======================================	=======	=========	=========	========
Part	Force	(kips)	Mom. Arm	Moment
	Vert.	Horiz.	(ft)	(ft-k)
=======================================	=======		=========	=======
Structure:				
Structure weight	24.469		-11.00	-269.05
Structure, driving side:				
Moist soil			-19.96	-109.27
Saturated soil			-17.47	-696.70
Water above structure			.00	.00
Water above soil			.00	.00
External vertical loads			.00	.00
Ext. horz. pressure loads		.000	.00	.00
Ext. horz. line loads		3.490	13.00	45.37
Structure, resisting side:				
Moist soil	.000		.00	.00
Saturated soil	.000		.00	.00
Water above structure	.000		.00	.00
Water above soil	4.612		~3.00	-13.84
Driving side:				
Effective earth loads		.909	4.30	3.91
Shear (due to delta)	.000		.00	.00
Horiz. surcharge effects		.000	.00	.00
Water loads		20.568	10.33	212.47
Resisting side:				
Effective earth loads		.000	.00	.00
Water loads		-8.303	5.43	-45.11
Foundation:				
Vertical force on base	-51.398		-10.60	544.98
Shear on base		(-16.665	.00	.00
Uplift	-23.047	7	-14.20	327.24
	========		=========	=========
** Statics Check ** SUMS =	.000	.000		.00
		-		
		(,	
		137,	4 / L	
		- < >//	•	

: DOES NOT IMPROL

Angle of base = .00 degrees
Normal force on base = 51.398 kips
Shear force on base = 16.665 kips
Max. available shear force = 26.000 kips

Base pressure at heel = .8834 ksfBase pressure at toe = 3.0703 ksf

Xr (measured from toe) = 10.60 ft
Resultant ratio = .4078
Stem ratio = .2308
Base in compression = 100.00 %
Overturning ratio = 1.93

Volume of concrete = 6.04 cubic yds/fr of wall

NOTE: The engineer shall verify that the computed bearing pressures below the wall do not exceed the allowable foundation bearing pressure, or, perform a bearing capacity analysis using the program CBEAR. Also, the engineer shall verify that the base pressures do not result in excessive differential settlement of the wall foundation.

******* ** Sliding Results ** *******

Stationary solution. Static sum of forces.

	Horizontal	Vertical
Wedge	Loads	Loads
Number	(kips)	(kips)
=======	=======================================	==========
1	.000	.000
2	19.760	4.612
3	.000	.000

Water pressures on wedges:

	Top	Bottom		
Wedge number	press. (ksf)	press. (ksf)	x-coord. (ft)	press. (ksf)
=======	========	========		========
1	.0000	.0000		
2			.0000	1.3750
2			26.0000	.6412
3	.0000	.0000		

Points of sliding plane: Point 1 (left), x = .00 ft, y = 508.00 ft Point 2 (right), x = 26.00 ft, y = 508.00 ft

Depth of cracking = 28.04 ft Crack extends to bottom of base of structure.

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1 2	.000	.000	.000 69.832	.000	.000
3	.000	.000	.000	.000	.000

Wedge	Net force		
number	(kips)		
=======			
1	.000		
2	3.877		
3	.000		
=======	========		
SUM =	3.877		

NOTE: Forces are calculated for the FS specified below.

```
+-----+
| Factor of safety = | 1.100 | +-----
```

