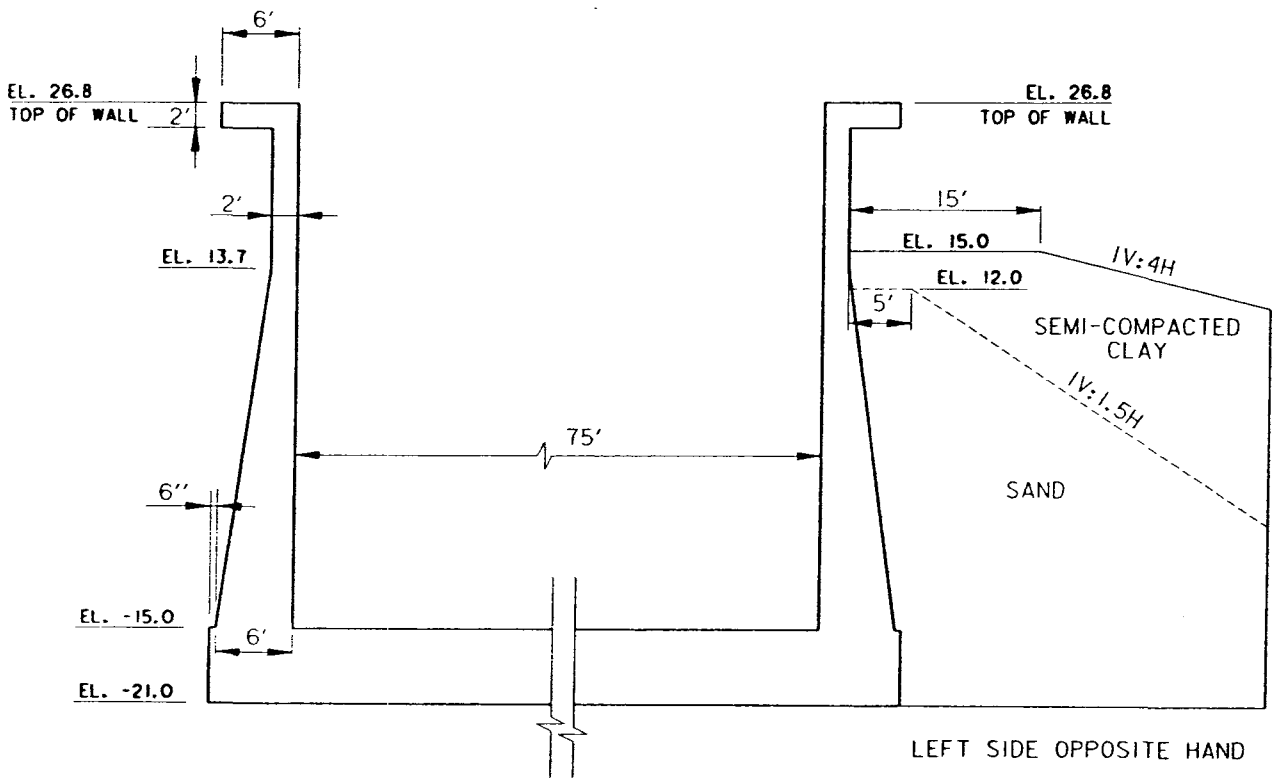
ANNEX 5 – STRUCTURAL CALCULATIONS

COMPUTATION SHEET

PROJECT	BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY CBW	DATE 4/01
SUBJECT			CHECKED BY	DATE



LEFT SIDE OPPOSITE HAND

SOIL PROPERTIES

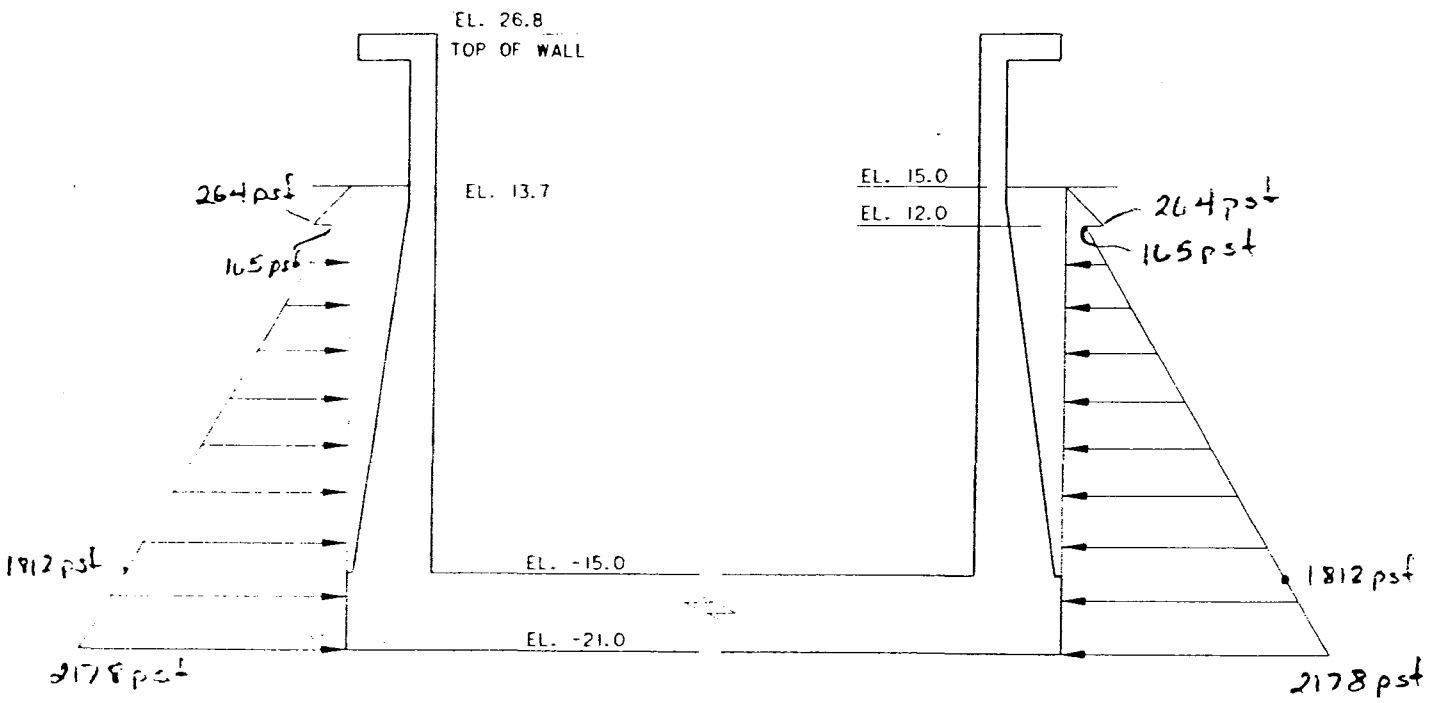
SAND: γ = 122 PCF Ku = 0.50

SEMI-COMPACTED CLAY: γ = 110 PCF Ku = 0.80

COMPUTATION SHEET

PROJECT BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

CONSTRUCTION CASE



MOMENT ABOUT EL -15.0

$$\tfrac{1}{2}(264\text{ psf})(13\text{ ft})(1\text{ ft})\left[\tfrac{1}{3}(3\text{ ft}) + 27\text{ ft}\right]$$
$$+\ 165\text{ psf}(27\text{ ft})(1\text{ ft})\left[\tfrac{1}{2}(27\text{ ft})\right] + \tfrac{1}{2}(1812\text{ psf} - 165\text{ psf})(27\text{ ft})(1\text{ ft})$$
$$\cdot\left[\tfrac{1}{3}(27\text{ ft})\right]$$

$$M = 11088\text{ ft-lb} + 60142.5\text{ ft-lb} + 200110.5\text{ ft-lb}$$

$$M = 271.3\text{ ft-k}$$

USE 86% FOR OVERSTRESS

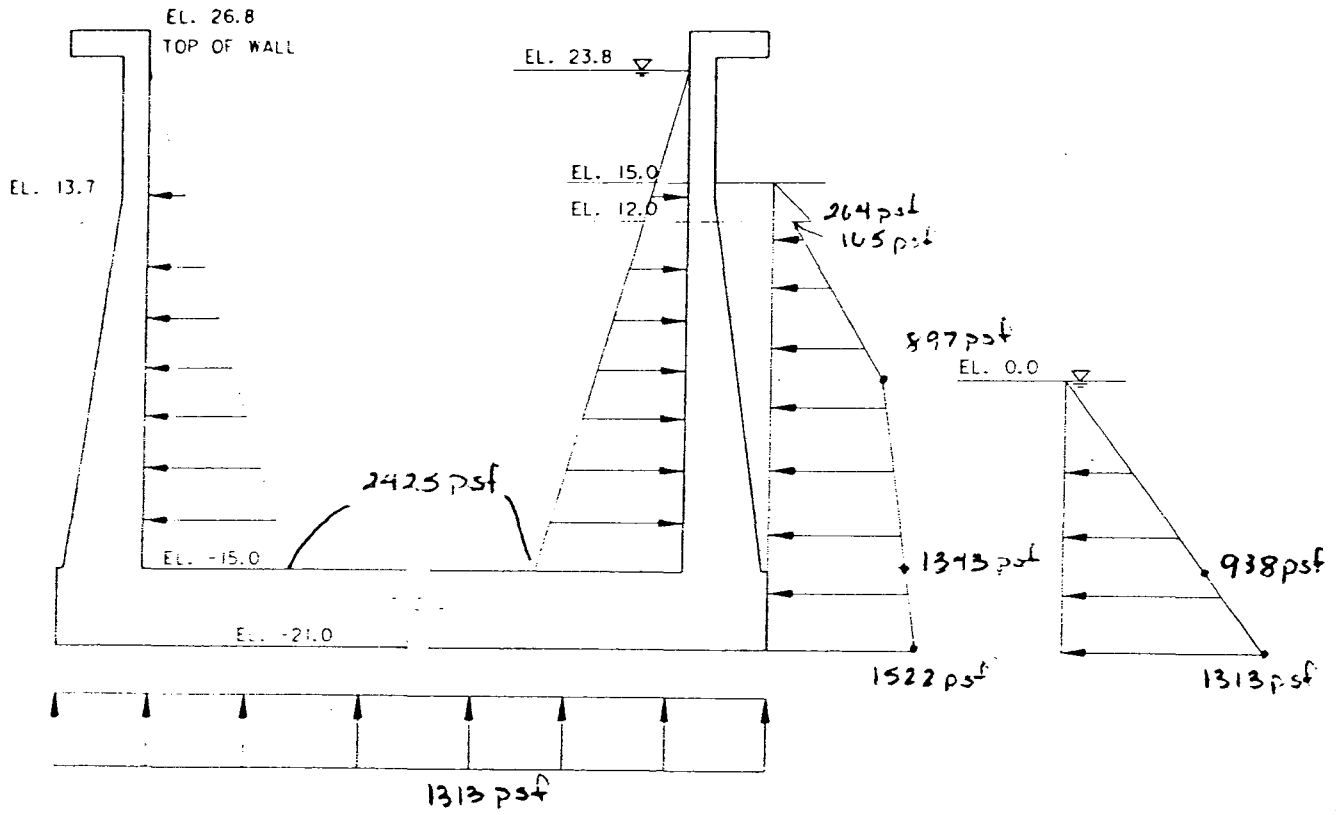
$$M = 233.4\text{ ft-k}$$

COMPUTATION SHEET

PROJECT BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

MAX. OPERATING CASE

H.W.= 23.8 TW= 0.0



MOMENT ABOUT EL -15.0

$$-\tfrac{1}{2}(2425\,psf)(38.8\,ft)(1\,ft)[\tfrac{1}{3}(38.8\,ft)] + \tfrac{1}{2}(264\,psf)(3\,ft)(1\,ft)$$
$$*[\tfrac{1}{3}(3\,ft) + 27\,ft] + 165\,psf\,(12\,ft)(1\,ft)[\tfrac{1}{2}(12) + 15\,ft] + \tfrac{1}{2}(897\,psf - 165\,psf)$$
$$*(12\,ft)(1\,ft) + \tfrac{1}{2}(1343\,psf - 897\,psf)(15\,ft)(1\,ft)[\tfrac{1}{3}(15\,ft)]$$
$$+\tfrac{1}{2}(938\,psf)(15\,ft)(1\,ft)[\tfrac{1}{3}(15\,ft)] + 897\,psf\,(15\,ft)(1\,ft)[\tfrac{1}{2}(15\,ft)]$$

$$M = -608448.7\,ft\text{-}lb + 11088\,ft\text{-}lb + 41580\,ft\text{-}lb + 83448\,ft\text{-}lb$$
$$+ 16725\,ft\text{-}lb + 35175\,ft\text{-}lb + 100912.5\,ft\text{-}lb$$

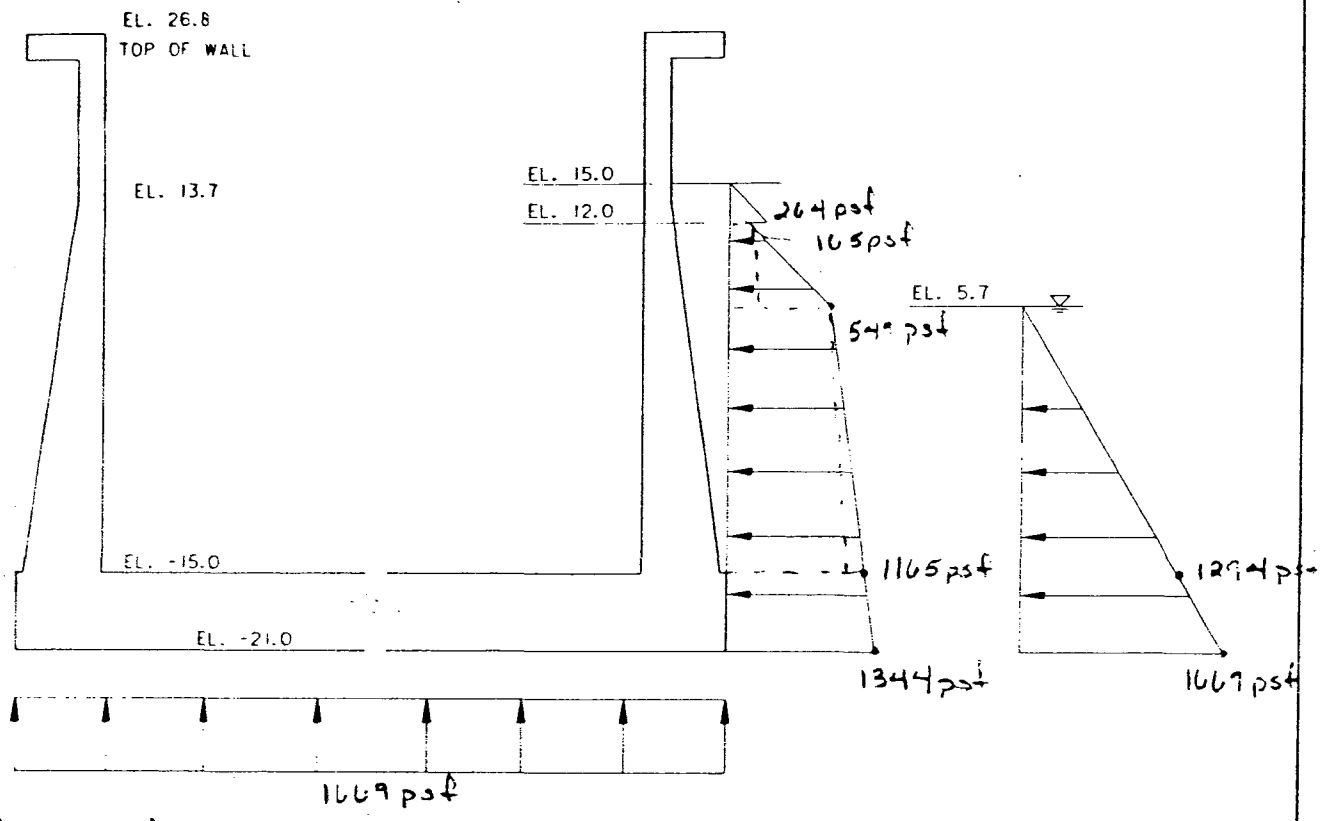
$$M = -319.5\,ft\text{-}k$$

COMPUTATION SHEET

PROJECT BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

DEWATERED CASE

WATER = 5.7



MOMENT ABOUT EL -15.0

$$\tfrac{1}{2}(264\text{ psf})(3\text{ ft})(1\text{ ft})\left[\tfrac{1}{3}(3\text{ ft}) + 27\text{ ft}\right] + 165\text{ psf}(6.3\text{ ft})(1\text{ ft})$$

$$\cdot\left[(\tfrac{1}{2})6.3\text{ ft} + 20.7\text{ ft}\right] + \tfrac{1}{2}(549\text{ psf} - 165\text{ psf})(6.3\text{ ft})(1\text{ ft})\left[\tfrac{1}{3}(6.3\text{ ft}) + 20.7\text{ ft}\right]$$

$$+ \tfrac{1}{2}(1165\text{ psf} - 549\text{ psf})(20.7\text{ ft})(1\text{ ft})\left[\tfrac{1}{2}(20.7\text{ ft})\right] + 549\text{ psf}(20.7\text{ ft})$$

$$\cdot(1\text{ ft})\left[\tfrac{1}{2}(20.7\text{ ft})\right] + \tfrac{1}{2}(1294\text{ psf})(20.7\text{ ft})(1\text{ ft})\left[\tfrac{1}{3}(20.7\text{ ft})\right]$$

$$M = 11088\text{ ft-lb} + 24792.1\text{ ft-lb} + 27578.7\text{ ft-lb} + 65987.5\text{ ft-lb}$$

$$+ 117070.1\text{ ft-lb} + 9241.0\text{ ft-lb}$$

USE 75% FOR OVERSTRESS $M = 254.6$ ft-k

COMPUTATION SHEET

PROJECT BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

MINIMUM WALL THICKNESS

AT EL -15.0

$M_{MAX} = 319.5$ ft-k

APPLY CORPS FACTORS

$M_u = 1.3(1.7)(319.5 \text{ ft-k})$

$M_u = 706.1$ ft-k

$M_n = M_u/.9 \quad , \quad \frac{706.1}{.9}$

$M_n = 784.6$ ft-k

FOR 3000 psi CONCRETE

$d_{req} = \sqrt{\frac{3.3274(M_n)}{b}}$

$= \sqrt{\frac{3.3274(784.6 \text{ ft-k})(12)}{12 \text{ in}}}$

$d_{req} = 51.1$ in

Req'd THICKNESS = 52 in + 6 in (cover)

= 58 in (4'-10")

Assume 6' for estimating

COMPUTATION SHEET

PROJECT: BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY	DATE
SUBJECT:		CHECKED BY	DATE

AT EL. 13.7

DETERMINE MOMENTS ABOUT EL 13.7 FOR MAX OPERATING CASE

$$M = \tfrac{1}{2}(631\ psf)(10.1\ ft)(1\ ft)[\tfrac{1}{3}(10.1\ ft)]$$
$$- \tfrac{1}{2}(114\ psf)(1.3\ ft)(1\ ft)[\tfrac{1}{3}(1.3\ ft)]$$

$$M = 10728.1\ ft\text{-}lb - 32.11\ ft\text{-}lb$$

$$M = 10.7\ ft\text{-}k$$

Apply Corps Factors

$$M_u = 1.3(1.7)(10.7\ ft\text{-}k) = 23.6\ ft\text{-}k$$

$$M_n = \frac{M_u}{.9} = \frac{23.6}{.9} = 26.3\ ft\text{-}k$$

For 3000 psi concrete

$$d_{req} = \sqrt{\frac{3.3274(M_n)}{b}}$$

$$= \sqrt{\frac{3.3274(26.3\ ft\text{-}k)(12)}{12}}$$

$$d_{req} = 9.4\ in$$

REQ'D THICKNESS = 9.4 + 3 = 13 in

COMPUTATION SHEET

PROJECT BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

SHEAR CHECK

AT EL -15.0

CONSTRUCTION CASE

$$\tfrac{1}{2}(264\,psf)(3\,ft)(1\,ft) + 165\,psf(27\,ft)(1\,ft)$$
$$+ \tfrac{1}{2}(1812\,psf - 165\,psf)(27\,ft)(1\,ft)$$

$$V = 396^{lb} + 4455^{lb} + 22234.5^{lb}$$

$$V = 27.1^{k}(.86) = 23.3^{k}$$

MAX OPERATING CASE

$$-\tfrac{1}{2}(2425\,psf)(38.8\,ft)(1\,ft) + \tfrac{1}{2}(264\,psf)(3\,ft)(1\,ft)$$
$$+ 165\,psf(12\,ft)(1\,ft) + \tfrac{1}{2}(897\,psf - 165\,psf)(12\,ft)(1\,ft)$$
$$+ \tfrac{1}{2}(1343\,psf - 897\,psf)(15\,ft)(1\,ft) + \tfrac{1}{2}(938\,psf)(15\,ft)(1\,ft)$$
$$+ 897\,psf(15\,ft)(1\,ft)$$

$$V = -47045^{lb} + 396^{lb} + 1980^{lb} + 4392^{lb} + 3345^{lb} + 7035^{lb}$$
$$+ 13455^{lb}$$

$$V = -16.4^{k}$$

DEWATERED CASE

$$\tfrac{1}{2}(264\,psf)(3\,ft)(1\,ft) + 165\,psf(6.3\,ft)(1\,ft)$$
$$+ \tfrac{1}{2}(549\,psf - 165\,psf)(6.3\,ft)(1\,ft) + \tfrac{1}{2}(1165\,psf - 549\,psf)$$
$$\times (20.7\,ft)(1\,ft) + 549\,psf(20.7\,ft)(1\,ft) + \tfrac{1}{2}(1294\,psf)(20.7\,ft)$$
$$\times (1\,ft)$$

$$V = 396^{lb} + 1039.5^{lb} + 1209.6^{lb} + 6375.6^{lb} + 11364.3^{lb}$$
$$+ 13392.9^{lb}$$

$$V = 33.78^{k}(.75) = 25.3^{k}$$

COMPUTATION SHEET

PROJECT BAYOU SORREL LOCK FEASIBILITY	PAGE OF	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

$V_{max} = 25.3^k$

APPLY CORPS FACTORS

$V_u = 1.3(1.7)25.3^k = 55.9^k$

SHEAR CAPACITY, V_c

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

$= 2(0.85)\sqrt{3000}\,(12")(52\,in)$

$\phi V_c = 58.1^k$

$\phi V_c > V_u$ OK

AT EL 13.7

MAX OPERATING CASE

$\frac{1}{2}(631\,psf)(10.1\,ft)(1\,ft) - \frac{1}{2}(114\,psf)(1.3\,ft)(1\,ft)$

$V = 3186.6^{lb} - 74.1^{lb}$

$V = 3.1^k$

APPLY CORPS FACTORS

$V_u = 3.1^k(1.3)(1.7) = 6.9^k$

SHEAR CAPACITY, V_c

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

$= 2(0.85)\sqrt{3000}\,(12")(21")$

$\phi V_c = 23.5^k$

$\phi V_c > V_u$ OK

PROGRAM CWFRAM - ANALYSIS OF TWO-DIMENSIONAL U-FRAME OR W-FRAME STRUCTURES
DATE 30-MAY-2002 TIME 17.02.51

I.--HEADING
'BAYOU SORREL LOCK
'CONSTRUCTION CASE WITH 14" CONCRETE PILES

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****************
*  INPUT DATA  *
****************
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II.--PLANE FRAME ANALYSIS
RIGID LINK FACTOR = .75
MEMBER FORCE FACTOR = 1.00

III.--STRUCTURE DATA

III.A.--MATERIAL PROPERTIES

MODULUS OF ELASTICITY OF CONCRETE	=	3.120E+06	(PSI)
POISSON'S RATIO FOR CONCRETE	=	.20	
UNIT WEIGHT OF CONCRETE	=	150.0	(PCF)
THICKNESS OF TWO-DIMENSIONAL SLICE	=	7.00	(FT)

III.B.--FLOOR DATA

FLOOR WIDTH	=	37.50	(FT)
FLOOR ELEVATION	=	-15.00	(FT)
FLOOR FILLET SIZE	=	.00	(FT)

III.C.--BASE DATA

III.C.1.--RIGHTSIDE

DISTANCE FROM CENTERLINE (FT)	ELEVATION (FT)
44.00	-21.00

III.C.2.--LEFTSIDE
SYMMETRIC WITH RIGHTSIDE.

III.D.--STEM DATA

III.D.1.--RIGHTSIDE

DISTANCE FROM STEM FACE (FT)	ELEVATION (FT)
6.00	26.80
6.00	24.80
2.00	24.80
2.00	13.70
6.00	-15.00
6.50	-15.00

III.D.2.--LEFTSIDE
SYMMETRIC WITH RIGHTSIDE.

III.E.--CULVERT DATA
NONE

III.F.--VOID DATA
NONE

IV.--BACKFILL DATA

IV.A.--RIGHTSIDE BACKFILL PRESSURE DATA

ELEVATION (FT)	VERTICAL PRESSURE (PSF)	HORIZONTAL PRESSURE (PSF)	SHEAR STRESS (PSF)
15.00	.00	.00	.00
13.70	.00	144.00	.00
12.00	.00	264.00	.00
12.00	.00	165.00	.00
-15.00	.00	1812.00	.00
-21.00	.00	2178.00	.00

IV.B.--LEFTSIDE BACKFILL PRESSURE DATA
SYMMETRIC WITH RIGHTSIDE

V.--BASE REACTION DATA

V.A.--RIGHTSIDE PILE DATA

V.A.1.--PILE LAYOUT DATA

<------START-----> PILE NO.	DIST. FROM CENTERLINE (FT)	STOP PILE NO.	PILE NO. STEP	STEP IN CL DIST. (FT)
1	.00	6	1	8.50

V.A.2.--PILE PROPERTIES

<----------START----------> PILE NO.	MODULUS OF ELASTICITY (PSI)	SECT AREA (SQIN)	MOMENT OF INERTIA (IN**4)	LENGTH (FT)	AXIAL COEFF	HEAD FIXITY	STOP PILE NO.	PILE NO. STEP
1	4.07E+06	196.00	3201.00	65.00	2.00	.00	6	1

V.A.3.--SOIL PROPERTIES

<----------START----------> PILE NO.	CONSTANT COEFFICIENT (PSI)	LINEAR COEFFICIENT (PCI)	STOP PILE NO.	PILE NO. STEP
1	180.000	.000	6	1

V.A.4.--PILE HEAD STIFFNESS MATRICES
NONE

V.A.4.--PILE BATTER DATA
NONE

V.A.5.--PILE LOAD COMPARISON DATA
NONE

V.B.-- LEFTSIDE PILE DATA
SYMMETRIC WITH RIGHTSIDE

VI.--WATER DATA
NONE

VII.--ADDITIONAL LOAD DATA
NONE

I.--HEADING
'BAYOU SORREL LOCK
'CONSTRUCTION CASE WITH 14" CONCRETE PILES

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*************************************
*  RESULTS OF EQUILIBRIUM ANALYSIS  *
*************************************
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II.--EFFECTS ON STRUCTURE RIGHTSIDE

II.A.--PRESSURES ON RIGHTSIDE SURFACE
(POSITIVE VERTICAL IS DOWN)
(POSITIVE HORIZONTAL IS TOWARD CENTERLINE)
(POSITIVE SHEAR IS DOWN)
(UNITS ARE POUNDS AND FEET)

	<---------BACKFILL PRESSURE--------->			GRND/SURCH
ELEVATION	VERTICAL	HORIZONTAL	SHEAR	WATER PRESSURE
26.800	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
24.800	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
24.800	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
15.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
13.700	0.0000E+00	1.4400E+02	0.0000E+00	0.0000E+00
12.000+	0.0000E+00	2.6400E+02	0.0000E+00	0.0000E+00
12.000-	0.0000E+00	1.6500E+02	0.0000E+00	0.0000E+00
-15.000	0.0000E+00	1.8120E+03	0.0000E+00	0.0000E+00
-15.000	0.0000E+00	1.8120E+03	0.0000E+00	0.0000E+00
-21.000	0.0000E+00	2.1780E+03	0.0000E+00	0.0000E+00

II.B.--PRESSURE ON RIGHTSIDE BASE
(POSITIVE PRESSURE IS UP; UNITS ARE POUNDS AND FEET)

DIST FROM CENTERLINE	SOIL REACTION PRESSURE	UPLIFT WATER PRESSURE
.000	0.0000E+00	0.0000E+00
8.500	0.0000E+00	0.0000E+00
17.000	0.0000E+00	0.0000E+00
25.500	0.0000E+00	0.0000E+00
34.000	0.0000E+00	0.0000E+00
37.500	0.0000E+00	0.0000E+00
42.500	0.0000E+00	0.0000E+00
44.000	0.0000E+00	0.0000E+00

II.C.--RESULTANTS OF LOADS ON STRUCTURE RIGHTSIDE
(POSITIVE VERTICAL IS DOWN)
(POSITIVE HORIZONTAL IS TOWARD CENTERLINE)
(POSITIVE MOMENT IS COUNTERCLOCKWISE ABOUT CHAMBER FLOOR CENTERLINE)
(UNITS ARE POUNDS AND FEET)

ITEM	HORIZONTAL	VERTICAL	MOMENT
BACKFILL	2.7370E+05	0.0000E+00	1.6492E+06
CONCRETE	0.0000E+00	4.3365E+05	-1.2288E+07
TOTAL THIS SIDE	2.7370E+05	4.3365E+05	-1.0638E+07

III.--EFFECTS ON STRUCTURE LEFTSIDE
SYMMETRIC WITH RIGHTSIDE

IV.--NET RESULTANTS OF ALL LOADS
(POSITIVE HORIZONTAL IS TO THE RIGHT)
(POSITIVE VERTICAL IS DOWN)
(POSITIVE MOMENT IS COUNTERCLOCKWISE ABOUT CENTERLINE)
(UNITS ARE POUNDS AND FEET)

```
TOTAL HORIZONTAL =   0.0000E+00
TOTAL VERTICAL   =   8.6730E+05
TOTAL MOMENT     =   0.0000E+00
```

V.--CONCRETE AREAS

```
RIGHTSIDE AREA =  4.1300E+02 (SQFT)
 LEFTSIDE AREA =  4.1300E+02 (SQFT)
TOTAL AREA     =  8.2600E+02 (SQFT)
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PROGRAM CWFRAM - ANALYSIS OF TWO-DIMENSIONAL U-FRAME OR W-FRAME STRUCTURES
DATE 30-MAY-2002 TIME 17.03.57

I.--HEADING
'BAYOU SORREL LOCK
'CONSTRUCTION CASE WITH 14" CONCRETE PILES

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**********************
*  FRAME MODEL DATA  *
**********************
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II.--RIGHTSIDE FRAME MODEL DATA

II.A.--RIGID BLOCK DATA (FT) - TYPE 1 MONOLITH
(NOTE 'X-COORD.' IS DISTANCE FROM CENTERLINE.)

		<----------CORNER LOCATIONS---------->						
BLOCK	CORNER NO.	1	2	3	4	5	6	CENTROID
1	X-COORD.	37.50	37.50	43.50	43.50	43.50	37.50	40.50
	ELEVATION	-21.00	-15.00	-15.00	-15.00	-21.00	-21.00	-18.00
6	X-COORD.	37.50	37.50	43.50	43.50	39.50	39.50	40.50
	ELEVATION	24.80	26.80	26.80	24.80	24.80	24.80	25.80

II.B.--JOINT COORDINATES (FT)
(NOTE 'X-COORD.' IS DISTANCE FROM CENTERLINE.)

JOINT NO.	X-COORD.	ELEVATION
1	.00000	-18.00000
2	8.50000	-18.00000
3	17.00000	-18.00000
4	25.50000	-18.00000
5	34.00000	-18.00000
6	40.50000	-18.00000
7	44.00000	-18.00000
8	38.50000	13.70000
9	40.50000	25.80000

II.C.--MEMBER DATA (FT)
(NOTE 'X-COORD.' IS DISTANCE FROM CENTERLINE.)

MEM NO	FROM JT	TO JT	<COORDS AT ENDS OF FLEX LENGTH> <--FROM END--> X	ELEV	<---TO END---> X	ELEV	<-MEMBER DEPTH--> FROM END	TO END
1	1	2	.00	-18.00	8.50	-18.00	6.00	6.00
2	2	3	8.50	-18.00	17.00	-18.00	6.00	6.00
3	3	4	17.00	-18.00	25.50	-18.00	6.00	6.00
4	4	5	25.50	-18.00	34.00	-18.00	6.00	6.00
5	5	6	34.00	-18.00	38.25	-18.00	6.00	6.00
6	6	7	42.75	-18.00	44.00	-18.00	6.00	6.00
7	6	8	40.55	-15.75	38.50	13.70	6.00	2.00
8	8	9	38.50	13.70	38.50	25.05	2.00	2.00

II.D.--PILE HEAD STIFFNESS COEFFICIENTS

PILE NO.	X-COORD. (FT)	BATTER (FT/FT)	<----------STIFFNESS COEFFICIENTS----------> B11 (LB/FT)	B22 (LB/FT)	B33 (LB-FT)	B13 (LB)
1	.00	.00	1.4091E+05	2.4569E+07	0.0000E+00	0.0000E+00
2	8.50	.00	1.4091E+05	2.4569E+07	0.0000E+00	0.0000E+00
3	17.00	.00	1.4091E+05	2.4569E+07	0.0000E+00	0.0000E+00
4	25.50	.00	1.4091E+05	2.4569E+07	0.0000E+00	0.0000E+00
5	34.00	.00	1.4091E+05	2.4569E+07	0.0000E+00	0.0000E+00
6	42.50	.00	1.4091E+05	2.4569E+07	0.0000E+00	0.0000E+00

III.-- LEFTSIDE FRAME MODEL DATA
SYMMETRIC WITH RIGHTSIDE

PROGRAM CWFRAM - ANALYSIS OF TWO-DIMENSIONAL U-FRAME OR W-FRAME STRUCTURES
DATE 30-MAY-2002 TIME 17.04.02

I.--HEADING
'BAYOU SORREL LOCK
'CONSTRUCTION CASE WITH 14" CONCRETE PILES

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*******************************
*  RESULTS OF FRAME ANALYSIS  *
*******************************
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II.--STRUCTURE DISPLACEMENTS

II.A.--RIGHTSIDE DISPLACEMENTS - TYPE 1 MONOLITH
(POSITIVE HORIZONTAL DISPLACEMENT IS TOWARD STRUCTURE CENTERLINE.)
(POSITIVE VERTICAL DISPLACEMENT IS DOWN.)
(POSITIVE ROTATION IS COUNTERCLOCKWISE.)

JT NO	DISTANCE FROM CTR-LINE (FT)	ELEVATION (FT)	<----DISPLACEMENT (FT OR RADIANS)----> HORIZONTAL	VERTICAL	ROTATION
		***** BASE JOINTS *****			
1	.00	-18.00	0.000E+00	2.959E-03	0.000E+00
2	8.50	-18.00	1.232E-04	3.163E-03	-4.324E-05
3	17.00	-18.00	2.465E-04	3.672E-03	-5.885E-05
4	25.50	-18.00	3.698E-04	4.111E-03	-8.022E-06
5	34.00	-18.00	4.931E-04	3.712E-03	1.629E-04
6	40.50	-18.00	5.548E-04	2.135E-03	3.108E-04
7	44.00	-18.00	5.603E-04	1.048E-03	3.106E-04
		***** STEM JOINTS *****			
8	38.50	13.70	2.306E-02	3.717E-03	5.384E-04
9	40.50	25.80	2.870E-02	2.957E-03	4.020E-04

II.B.-- LEFTSIDE DISPLACEMENTS - TYPE 1 MONOLITH