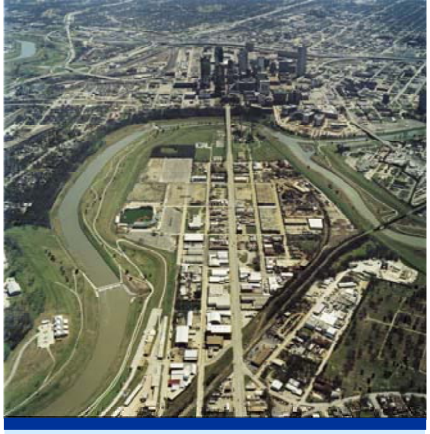
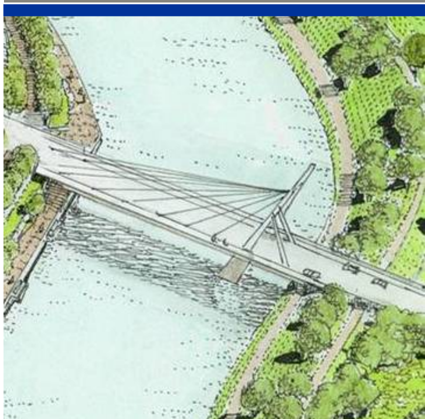
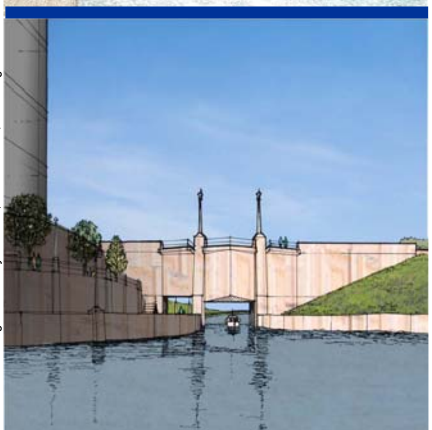






Images courtesy of CDM, Gideon Toal, and Bing Thom Architects

Fort Worth Central City Preliminary Design

Civil/Structural Preliminary Design

Draft Environmental Impact Statement

Appendix C

May 2005

Volume VI – Stability Analysis Retaining Walls

STABILITY ANALYSES FOR RETAINING WALLS

Contents: Retaining Walls

Volume VI

Section 1
Lower Level Retaining Walls -
Computer Runs for the Retaining Walls

Lower Level Retaining Walls: I1NSLL

Normal pool condition

1. Short-term soil properties assumed
2. Hydrostatic pressure to El 530 on driving side
3. Water at normal pool level, El 524.3, on resisting side
4. Passive soil pressure neglected on resisting side
5. 100 psf vertical surcharge pressure applied

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

Date: **/11/14                                      Time: 13.33.33

Flood Wall Stability Analysis Using CTWALL
Filename: I1NSLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   530.00 ft
  Height of stem (HTS)                     =    12.00 ft
  Thickness top of stem (TTS)              =     1.17 ft
  Thickness bottom of stem (TBS)           =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.50 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.50 ft
  Width of toe (TWIDTH)                    =     2.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    10.00 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    516.50
       .00    518.00
      6.83    518.00
      6.83    530.00
      8.00    530.00
      8.00    518.00
     10.00    518.00
     10.00    516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1493.17	530.00
2	6.83	530.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	10.00	516.50
2	510.00	516.50

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 ***
* Overturning *     Required base in comp. = 100.00 %
***************     Actual base in comp.   = 100.00 %
                    Overturning ratio      =   1.57

Xr (measured from toe) =   3.58 ft
Resultant ratio        =  .3584
Stem ratio             =  .2000
Base pressure at heel =     .1477 ksf
Base pressure at toe  =    1.8173 ksf

***********     *** Satisfied ***
* Sliding *     Min. Required =   1.50
***********     Actual FS     =   2.64
```

```
********************** Output Results **********************

Date: **/11/14                                   Time: 13.33.33

Flood Wall Stability Analysis Using CTWALL
Filename: I1NSLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          =    .0000
Calculated earth pressure coefficients:
  Driving side at rest K    =    .0000
  Driving side at rest Kc   =    .0000
  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 =    13.50 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       516.50      .8438

  Surcharge pressures:
       Elev.   Press.
       (ft)    (ksf)
    ===================

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
524.30	.0000
516.50	.4875
516.50	.4875

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.8438
10.00	.4875

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	4.356		-3.83	-16.69
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	10.655		-6.58	-70.16
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.683		-6.59	-4.50
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...........	.787		-1.00	-.79
Driving side:				
Effective earth loads......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		5.695	4.50	25.63
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		-1.901	2.60	-4.95
Foundation:				
Vertical force on base.....	-9.825		-3.58	35.21
Shear on base..............		-3.794	.00	.00
Uplift.....................	-6.656		-5.45	36.25
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base          =      .00 degrees
Normal force on base =    9.825 kips
Shear force on base  =    3.794 kips
Max. available shear force =   10.000 kips

Base pressure at heel =    .1477 ksf
Base pressure at toe  =   1.8173 ksf

Xr (measured from toe) =     3.58 ft
Resultant ratio         =    .3584
Stem ratio              =    .2000
Base in compression     =   100.00 %
Overturning ratio       =     1.57

Volume of concrete =     1.08 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	.000
2	3.794	1.470
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0000		
2			.0000	.8438
2			10.0000	.4875
3	.0000	.0000		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 516.50 ft
Point 2 (right), x = 10.00 ft, y = 516.50 ft

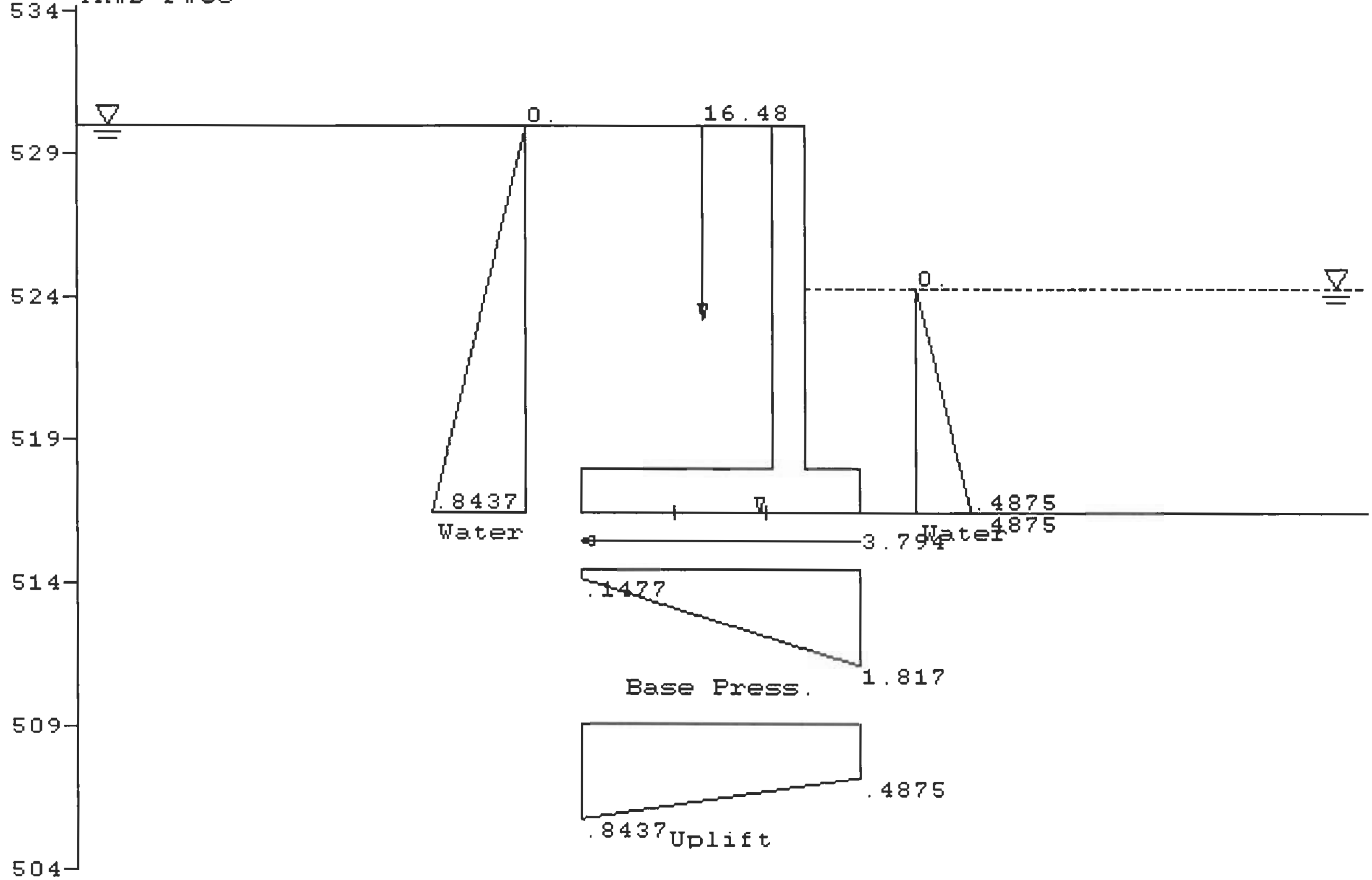
Depth of cracking = 13.50 ft
Crack extends to bottom of base of structure.

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	10.000	15.011	10.000	6.656
3	.000	.000	.000	.000	.000

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

Factor of safety = 2.635

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Lower Level Retaining Walls: I1NLLL

Normal pool condition

1. Long-term soil properties assumed

2. Hydrostatic pressure to El 530 on driving side

3. Water at normal pool level, El 524.3, on resisting side

4. Passive soil pressure neglected on resisting side

5. 100 psf vertical surcharge pressure applied

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

Date: **/11/14                                    Time: 13.37.21

Flood Wall Stability Analysis Using CTWALL
Filename: I1NLLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)         =   530.00 ft
  Height of stem (HTS)                    =    12.00 ft
  Thickness top of stem (TTS)             =     1.17 ft
  Thickness bottom of stem (TBS)          =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=        .00 ft
  Depth of heel (THEEL)                   =     1.50 ft
  Distance of batter for heel (BTRH)      =      .00 ft
  Depth of toe (TTOE)                     =     1.50 ft
  Width of toe (TWIDTH)                   =     2.00 ft
  Distance of batter for toe (BTRT)       =      .00 ft
  Width of base (BWIDTH)                  =    16.00 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    516.50
       .00    518.00
     12.83    518.00
     12.83    530.00
     14.00    530.00
     14.00    518.00
     16.00    518.00
     16.00    516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1487.17	530.00
2	12.83	530.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	16.00	516.50
2	516.00	516.50

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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.02

Xr (measured from toe) =   6.68 ft
Resultant ratio        =  .4172
Stem ratio             =  .1250
Base pressure at heel =     .5802 ksf
Base pressure at toe  =    1.7255 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   1.53
```

```
********************** Output Results **********************

Date: **/11/14                                Time: 13.37.21

Flood Wall Stability Analysis Using CTWALL
Filename: I1NLLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          = -54.4285
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  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
       516.50      .6807

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       516.50      .5514
```

Surcharge pressures:

Elev. (ft)	Press. (ksf)
530.00	.051
516.50	.051

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
524.30	.0000
516.50	.4875
516.50	.4875

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.6807
16.00	.4875

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	5.706		-6.00	-34.24
Structure, driving side:				
Moist soil................	.000		.00	.00
Saturated soil............	20.015		-9.58	-191.84
Water above structure......	.000		.00	.00
Water above soil..........	.000		.00	.00
External vertical loads....	1.283		-9.59	-12.30
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..........	.787		-1.00	-.79
Driving side:				
Effective earth loads......		3.722	4.50	16.75
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.693	6.75	4.68
Water loads...............		4.595	4.50	20.67
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads...............		-1.901	2.60	-4.95
Foundation:				
Vertical force on base.....	-18.446		-6.68	123.13
Shear on base.............		-7.109	.00	.00
Uplift....................	-9.346		-8.44	78.89
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 18.446 kips
Shear force on base = 7.109 kips
Max. available shear force = 10.998 kips

Base pressure at heel = .5802 ksf
Base pressure at toe = 1.7255 ksf

Xr (measured from toe) = 6.68 ft
Resultant ratio = .4172
Stem ratio = .1250
Base in compression = 100.00 %
Overturning ratio = 2.02

Volume of concrete = 1.41 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	.973
2	-1.901	2.070
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.6807		
2			.0000	.6807
2			16.0000	.4875
3	.0000	.0000		

Points of sliding plane:
Point 1 (left), x =   .00 ft,   y =   516.50 ft
Point 2 (right), x =   16.00 ft,   y =   516.50 ft

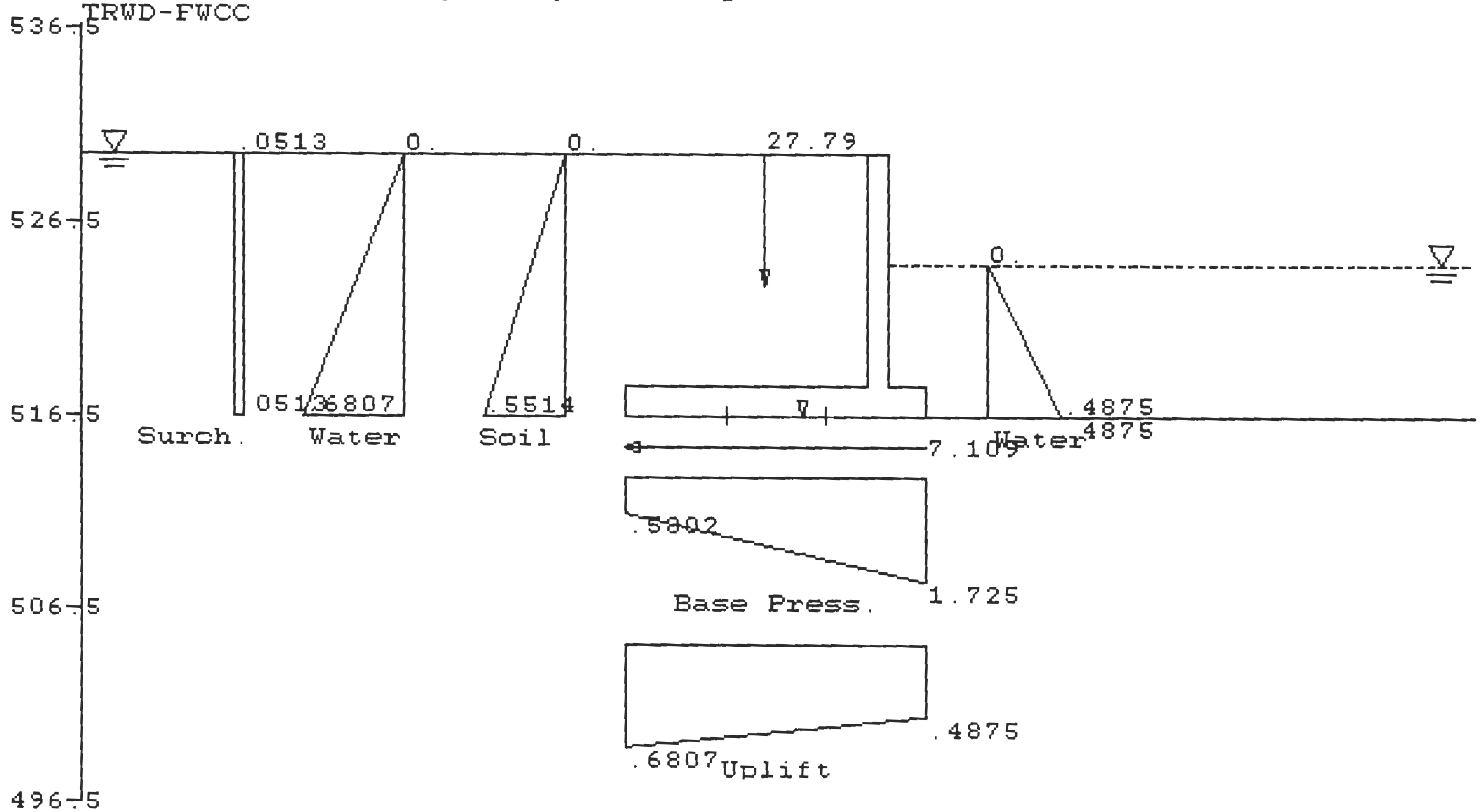
Depth of cracking =   .00 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	-54.230	16.638	8.534	16.638	5.663
2	.000	16.000	25.721	16.000	9.346
3	.000	.000	.000	.000	.000

Wedge number	Net force (kips)
1	-9.073
2	9.073
3	.000
SUM =	.000

```
+-----------------------------+
| Factor of safety =    1.534 |
+-----------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Lower Level Retaining Walls: I1FLLL

Flood / Drawdown condition

1. Long-term soil properties assumed

2. Hydrostatic pressure to El 530 on driving side

3. Water at El 516.50 on resisting side

4. Passive soil pressure neglected on resisting side (conservative)

5. No surcharge pressure applied

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

Date: **/01/06 Time: 17.34.23

Flood Wall Stability Analysis Using CTWALL
Filename: I1FLLL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: WCS

Structural geometry data:

Elevation of top of stem (ELTS)	=	530.00	ft
Height of stem (HTS)	=	12.00	ft
Thickness top of stem (TTS)	=	1.17	ft
Thickness bottom of stem (TBS)	=	1.17	ft
Dist. of batter at bot. of stem (TBSR)	=	.00	ft
Depth of heel (THEEL)	=	1.50	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	1.50	ft
Width of toe (TWIDTH)	=	2.00	ft
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	13.00	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	516.50
.00	518.00
9.83	518.00
9.83	530.00
11.00	530.00
11.00	518.00
13.00	518.00
13.00	516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1490.17	530.00
2	9.83	530.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	13.00	516.50
2	513.00	516.50

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 = 526.00 ft
Resisting side elevation = 522.00 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.20

Xr (measured from toe) =   5.40 ft
Resultant ratio        =  .4155
Stem ratio             =  .1538
Base pressure at heel =     .5416 ksf
Base pressure at toe  =    1.6551 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   1.53
```

```
********************** Output Results **********************

Date: **/01/06                                   Time: 17.34.23

Flood Wall Stability Analysis Using CTWALL
Filename: I1FLLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: WCS

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4285
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  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)
    ======================
       526.00      .0000
       516.50      .4882

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       526.00      .2053
       516.50      .5886

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
522.00	.0000
516.50	.3438
516.50	.3438

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.4882
13.00	.3438

** Forces and moments **

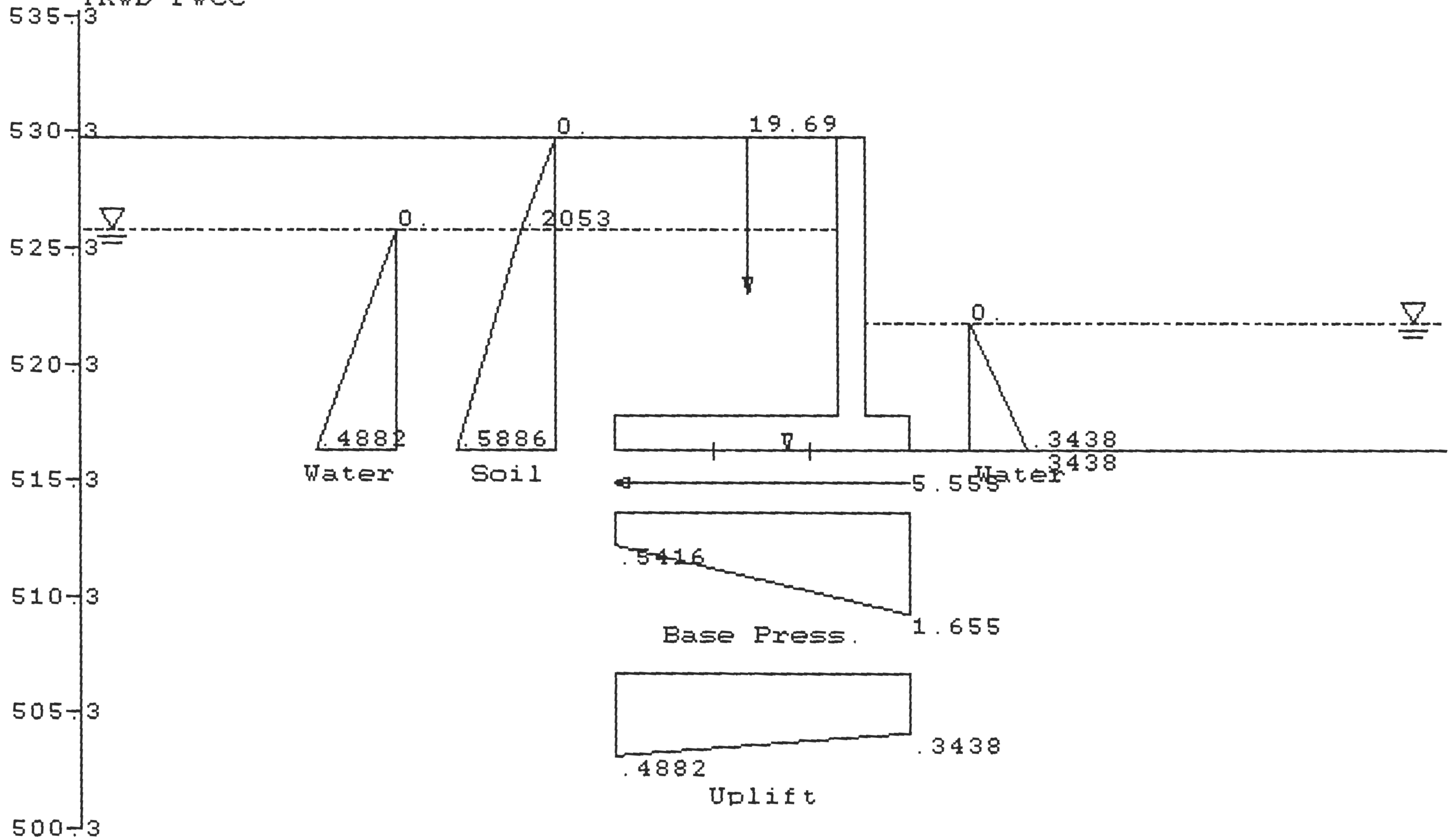
Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	5.031		-4.86	-24.46
Structure, driving side:				
Moist soil.................	3.932		-8.08	-31.79
Saturated soil.............	10.223		-8.09	-82.65
Water above structure......	.000		.00	.00
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...........	.500		-1.00	-.50
Driving side:				
Effective earth loads......		4.182	4.66	19.48
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		2.319	3.17	7.34
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		-.945	1.83	-1.73
Foundation:				
Vertical force on base.....	-14.279		-5.40	77.13
Shear on base..............		-5.555	.00	.00
Uplift.....................	-5.408		-6.88	37.18
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base          =      .00 degrees
Normal force on base =   14.279 kips
Shear force on base  =    5.555 kips
Max. available shear force =    8.575 kips

Base pressure at heel =    .5416 ksf
Base pressure at toe  =   1.6551 ksf

Xr (measured from toe) =     5.40 ft
Resultant ratio        =    .4155
Stem ratio             =    .1538
Base in compression    =   100.00 %
Overturning ratio      =     2.20

Volume of concrete =     1.24 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        -.945         .500
     3         .000         .000

  Water pressures on wedges:

              Top       Bottom
    Wedge    press.    press.    x-coord.     press.
    number   (ksf)     (ksf)      (ft)        (ksf)
  ================================================
      1     .0000     .4882
      2                            .0000       .4882
      2                          13.0000       .3438
      3     .0000     .0000

Points of sliding plane:
  Point 1 (left),  x =       .00 ft,   y =   516.50 ft
  Point 2 (right), x =     13.00 ft,   y =   516.50 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    -54.339    16.616      7.510    11.693       2.854
     2       .000    13.000     19.186    13.000       5.408
     3       .000      .000       .000      .000        .000

  Wedge       Net force
  number       (kips)
  ===================
     1        -6.552
     2         6.553
     3          .000
  ===================
     SUM =      .001

+------------------------------+
| Factor of safety =    1.529 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Lower Level Retaining Walls: I1FSLL

Flood / Drawdown condition

1. Short-term soil properties assumed
2. Hydrostatic pressure to El 530 on driving side
3. Water at El 516.50 on resisting side
4. Passive soil pressure neglected on resisting side (conservative)
5. No surcharge pressure applied

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

Date: **/01/06                                   Time: 17.24.35

Flood Wall Stability Analysis Using CTWALL
Filename: I1FSLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: WCS

Structural geometry data:
  Elevation of top of stem (ELTS)        =   530.00 ft
  Height of stem (HTS)                   =    12.00 ft
  Thickness top of stem (TTS)            =     1.17 ft
  Thickness bottom of stem (TBS)         =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=       .00 ft
  Depth of heel (THEEL)                  =     1.50 ft
  Distance of batter for heel (BTRH)     =      .00 ft
  Depth of toe (TTOE)                    =     1.50 ft
  Width of toe (TWIDTH)                  =     2.00 ft
  Distance of batter for toe (BTRT)      =      .00 ft
  Width of base (BWIDTH)                 =    12.00 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    516.50
       .00    518.00
      8.83    518.00
      8.83    530.00
     10.00    530.00
     10.00    518.00
     12.00    518.00
     12.00    516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1491.17	530.00
2	8.83	530.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	12.00	516.50
2	512.00	516.50

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 = 516.51 ft
  Unit weight of water = .0625 kcf
  Seepage pressures computed by Line of Creep method.

```
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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.91

Xr (measured from toe) =   4.44 ft
Resultant ratio        =  .3699
Stem ratio             =  .1667
Base pressure at heel =     .2470 ksf
Base pressure at toe  =    2.0054 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   2.11
```

```
********************** Output Results **********************

Date: **/01/06                                    Time: 17.24.35

Flood Wall Stability Analysis Using CTWALL
Filename: I1FSLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: WCS

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          =    .0000
Calculated earth pressure coefficients:
  Driving side at rest K    =    .0000
  Driving side at rest Kc   =    .0000
  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 =    13.50 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       516.50      .8438

** Resisting side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       516.51      .0000
       516.50      .0006
       516.50      .0006
```

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.8438
12.00	.0006

** Forces and moments **

Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	4.806		-4.50	-21.64
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	13.775		-7.59	-104.48
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...........	.000		.00	.00
Driving side:				
Effective earth loads......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		5.695	4.50	25.63
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	2.33	.00
Foundation:				
Vertical force on base.....	-13.515		-4.44	59.99
Shear on base..............		-5.695	.00	.00
Uplift.....................	-5.066		-8.00	40.52
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 13.515 kips
Shear force on base = 5.695 kips
Max. available shear force = 12.000 kips

Base pressure at heel = .2470 ksf
Base pressure at toe = 2.0054 ksf

```
Xr (measured from toe) =     4.44 ft
Resultant ratio        =    .3699
Stem ratio             =    .1667
Base in compression    =   100.00 %
Overturning ratio      =     1.91
```

Volume of concrete = 1.19 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	.000
2	5.695	.000
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0000		
2			.0000	.8438
2			12.0000	.0006
3	.0000	.0000		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 516.50 ft
Point 2 (right), x = 12.00 ft, y = 516.50 ft

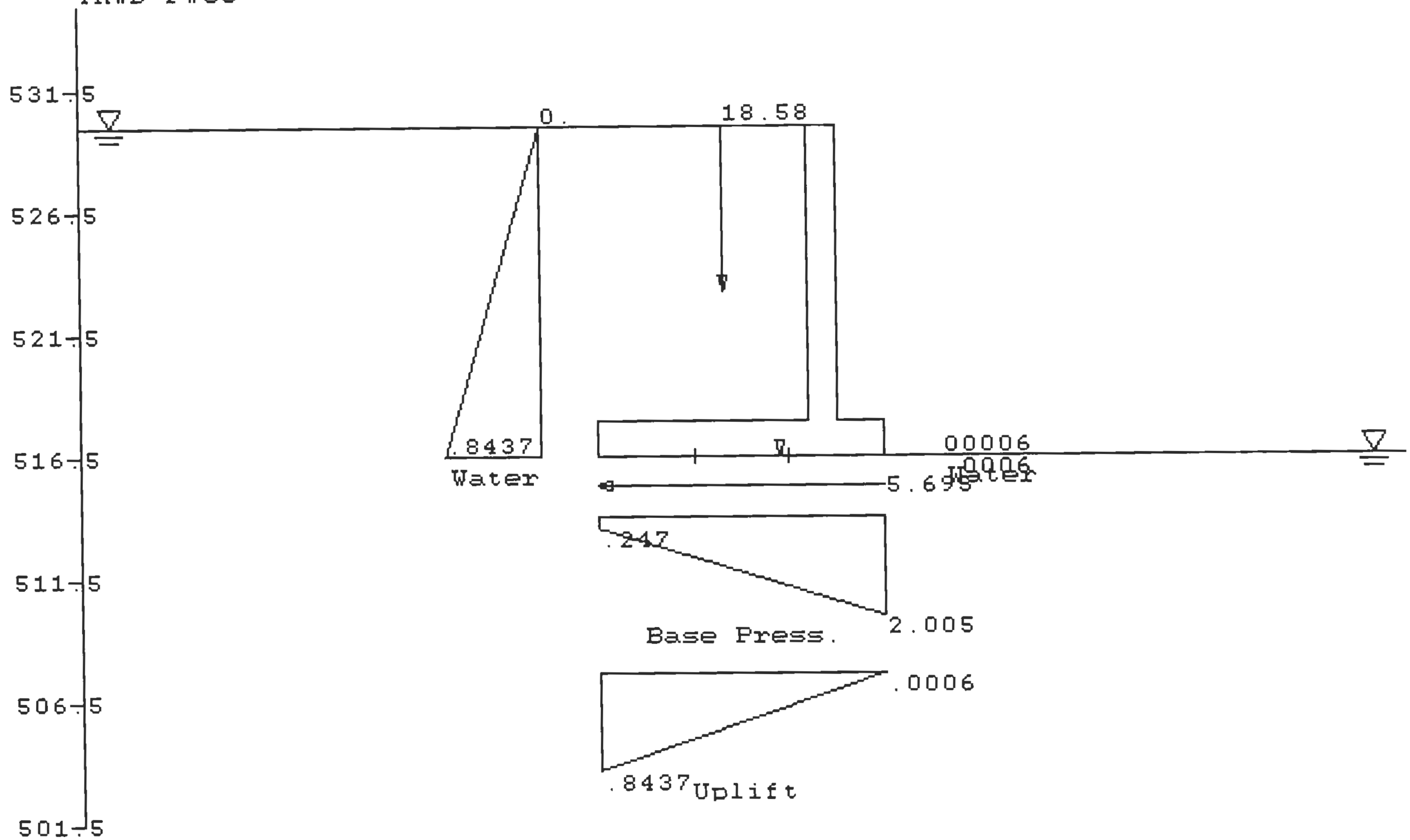
Depth of cracking = 13.50 ft
Crack extends to bottom of base of structure.

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	12.000	18.581	12.000	5.066
3	.000	.000	.000	.000	.000

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

Factor of safety = 2.107

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Lower Level Retaining Walls: I3ESLL

Earthquake condition

1. Short-term soil properties assumed

2. Hydrostatic pressure to El 530 on driving side

3. Water at normal pool level, El 524.3, on resisting side

4. Passive soil pressure neglected on resisting side

5. No surcharge pressure

6. Lateral seismic forces included

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

Date: **/11/18 Time: 14.55.54

Flood Wall Stability Analysis Using CTWALL
Filename: I3ESLL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: WCS

Structural geometry data:

Elevation of top of stem (ELTS)	=	530.00	ft
Height of stem (HTS)	=	12.00	ft
Thickness top of stem (TTS)	=	1.17	ft
Thickness bottom of stem (TBS)	=	1.17	ft
Dist. of batter at bot. of stem (TBSR)	=	.00	ft
Depth of heel (THEEL)	=	1.50	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	1.50	ft
Width of toe (TWIDTH)	=	1.00	ft
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	16.00	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	516.50
.00	518.00
13.83	518.00
13.83	530.00
15.00	530.00
15.00	518.00
16.00	518.00
16.00	516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1486.17	530.00
2	13.83	530.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	16.00	516.50
2	516.00	516.50

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 (ft)	Force (kips)
523.25	1.36

Minimum required factors of safety:
  Sliding FS   =   1.10
  Overturning   =   .10% 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 ***
* Overturning *    Required base in comp. =    .10 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.83

Xr (measured from toe) =   6.21 ft
Resultant ratio        =  .3880
Stem ratio             =  .0625
Base pressure at heel =     .3489 ksf
Base pressure at toe  =    1.7792 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.10
***********    Actual FS     =   3.10
```

```
********************** Output Results **********************

Date: **/11/18                                   Time: 14.55.54

Flood Wall Stability Analysis Using CTWALL
Filename: I3ESLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: WCS

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          =    .0000
Calculated earth pressure coefficients:
  Driving side at rest K    =    .0000
  Driving side at rest Kc   =    .0000
  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 =    13.50 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       516.50      .8438

** Resisting side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       524.30      .0000
       516.50      .4875
       516.50      .4875
```

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.8438
16.00	.4875

** Forces and moments **

Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	5.706		-5.63	-32.14
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	21.575		-9.09	-196.01
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......		1.360	6.75	9.18
Structure, resisting side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.394		-.50	-.20
Driving side:				
Effective earth loads......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		5.695	4.50	25.63
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		-1.901	2.60	-4.95
Foundation:				
Vertical force on base.....	-17.025		-6.21	105.68
Shear on base..............		-5.154	.00	.00
Uplift.....................	-10.650		-8.71	92.80
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 17.025 kips
Shear force on base = 5.154 kips
Max. available shear force = 16.000 kips

Base pressure at heel = .3489 ksf
Base pressure at toe = 1.7792 ksf

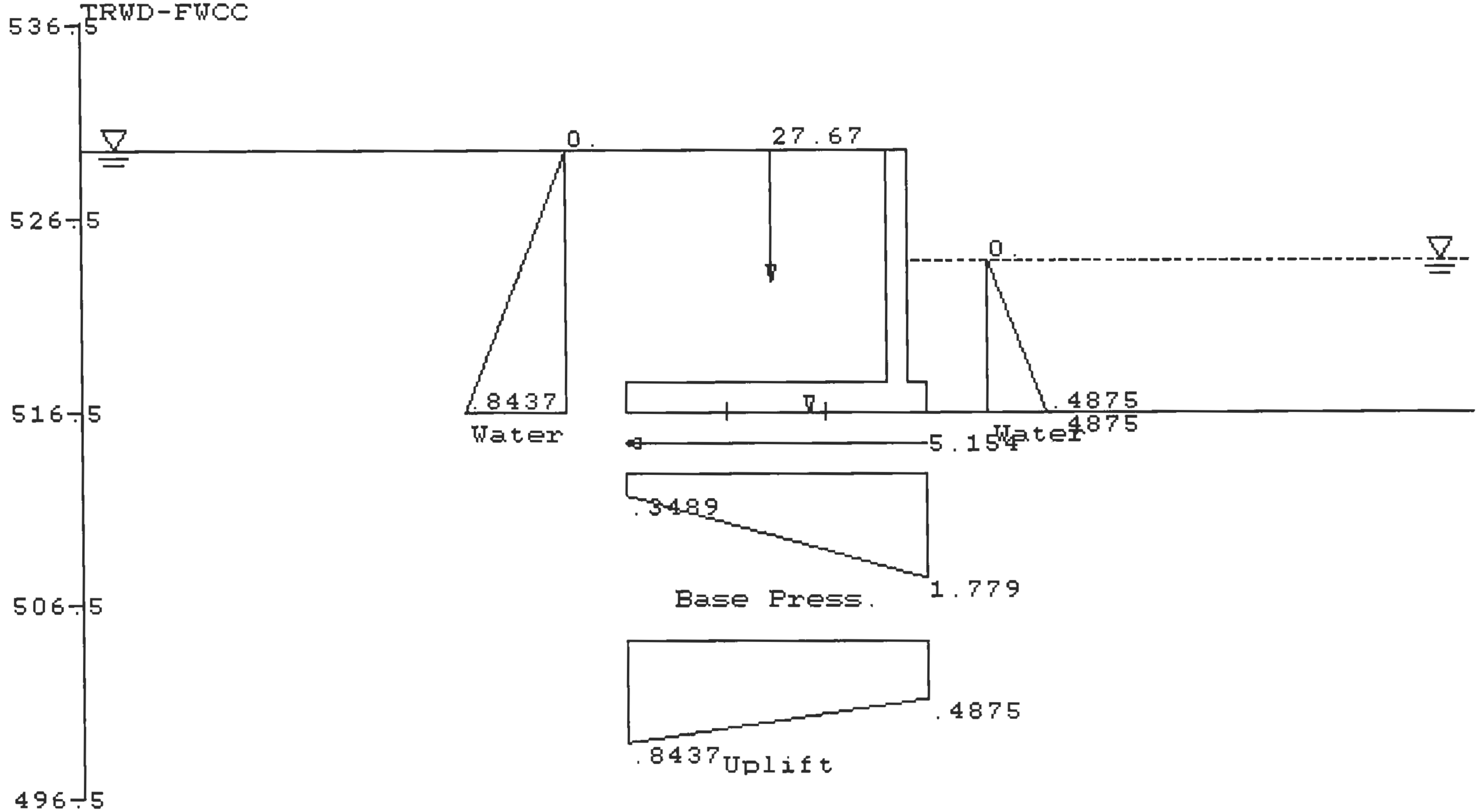
```
Xr (measured from toe) =     6.21 ft
Resultant ratio        =    .3880
Stem ratio             =    .0625
Base in compression    =   100.00 %
Overturning ratio      =     1.83
```

Volume of concrete =   1.41 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        5.154         .394
     3         .000         .000

  Water pressures on wedges:

              Top      Bottom
    Wedge    press.   press.   x-coord.    press.
    number   (ksf)    (ksf)     (ft)       (ksf)
  ================================================
      1     .0000     .0000
      2                           .0000      .8438
      2                         16.0000      .4875
      3     .0000     .0000

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   516.50 ft
  Point 2 (right), x =    16.00 ft,   y =   516.50 ft

Depth of cracking =    13.50 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   16.000     27.281    16.000     10.650
     3      .000     .000       .000      .000       .000

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

+------------------------------+
| Factor of safety =    3.104 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Lower Level Retaining Walls: I3ELLL

Earthquake condition

1. Long-term soil properties assumed

2. Hydrostatic pressure to El 530 on driving side

3. Water at normal pool level, El 524.3, on resisting side

4. Passive soil pressure neglected on resisting side

5. No surcharge pressure

6. Lateral seismic forces included

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

Date: **/11/18                                Time: 15.02.05

Flood Wall Stability Analysis Using CTWALL
Filename: I3ELLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: WCS

Structural geometry data:
  Elevation of top of stem (ELTS)          =   530.00 ft
  Height of stem (HTS)                     =    12.00 ft
  Thickness top of stem (TTS)              =     1.17 ft
  Thickness bottom of stem (TBS)           =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.50 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.50 ft
  Width of toe (TWIDTH)                    =     1.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    16.00 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    516.50
       .00    518.00
     13.83    518.00
     13.83    530.00
     15.00    530.00
     15.00    518.00
     16.00    518.00
     16.00    516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.100	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1486.17	530.00
2	13.83	530.00

Resisting side scil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.100	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	16.00	516.50
2	516.00	516.50

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.

Horizontal line load data:

Elevation (ft)	Force (kips)
520.62	3.92

Minimum required factors of safety:
  Sliding FS   =   1.10
  Overturning =   .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

***************    *** Satisfied ***
* Overturning *    Required base in comp. =    .10 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.81

Xr (measured from toe) =   5.71 ft
Resultant ratio        =  .3569
Stem ratio             =  .0625
Base pressure at heel =     .1620 ksf
Base pressure at toe  =    2.1291 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.10
***********    Actual FS     =   1.10
```

```
********************** Output Results **********************

Date: **/11/18                                   Time: 15.02.05

Flood Wall Stability Analysis Using CTWALL
Filename: I3ELLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: WCS

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          = -54.1821
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  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 =    -1.22 ft

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       531.22     -.0763
       516.50      .6807

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       531.22      .0000
       530.00      .0000
       516.50      .4559

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
524.30	.0000
516.50	.4875
516.50	.4875

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.6807
16.00	.4875

** Forces and moments **

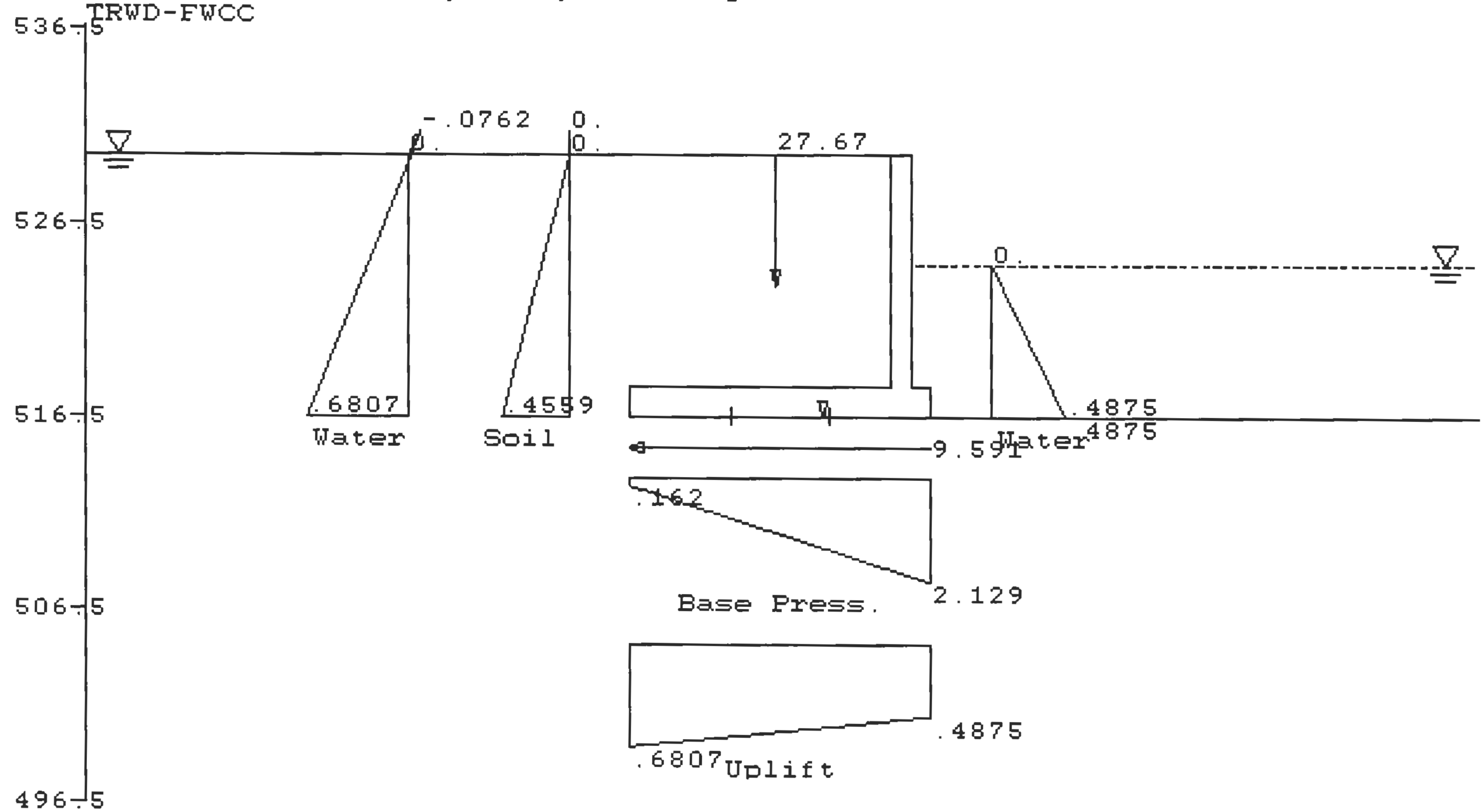
Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	5.706		-5.63	-32.14
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	21.575		-9.09	-196.01
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.000		.00	.00
Ext. horz. pressure loads..		.000	.00	.00
Ext. horz. line loads......		3.920	4.12	16.15
Structure, resisting side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.394		-.50	-.20
Driving side:				
Effective earth loads......		3.077	4.50	13.85
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		4.495	4.39	19.74
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		-1.901	2.60	-4.95
Foundation:				
Vertical force on base.....	-18.329		-5.71	104.67
Shear on base..............		-9.591	.00	.00
Uplift.....................	-9.346		-8.44	78.89
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base          =      .00 degrees
Normal force on base =   18.329 kips
Shear force on base  =    9.591 kips
Max. available shear force =   10.939 kips

Base pressure at heel =    .1620 ksf
Base pressure at toe  =   2.1291 ksf

Xr (measured from toe) =     5.71 ft
Resultant ratio          =    .3569
Stem ratio               =    .0625
Base in compression      =   100.00 %
Overturning ratio        =     1.81

Volume of concrete =     1.41 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       2.019        .394
     3        .000        .000

  Water pressures on wedges:

            Top      Bottom
    Wedge   press.   press.   x-coord.    press.
    number  (ksf)    (ksf)     (ft)       (ksf)
  ================================================
     1     .0000    .6807
     2                           .0000     .6807
     2                         16.0000     .4875
     3     .0000    .0000

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   516.50 ft
  Point 2 (right), x =    16.00 ft,   y =   516.50 ft

Depth of cracking =    -1.26 ft

          Failure   Total    Weight    Submerged    Uplift
  Wedge    angle    length  of wedge    length      force
  number   (deg)     (ft)    (kips)      (ft)       (kips)
  ==========================================================
     1   -57.908   17.421      7.364   17.421      5.929
     2      .000   16.000     27.281   16.000      9.346
     3      .000     .000       .000     .000       .000

  Wedge     Net force
  number     (kips)
  ===================
     1       -6.051
     2        7.926
     3         .000
  ===================
     SUM =    1.875

NOTE: Forces are calculated for the FS specified below.

+------------------------------+
| Factor of safety =    1.100 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Lower Level Retaining Walls: I4CSLL

Construction / Maintenance condition

1. Short-term soil properties assumed

2. Hydrostatic pressure to El 530 on driving side

3. Water at base of wall on resisting side

4. Passive soil pressure neglected on resisting side

5. 100 psf vertical surcharge pressure applied

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


Date: **/11/14                                     Time: 13.38.09

Flood Wall Stability Analysis Using CTWALL
Filename: I4CSLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   530.00 ft
  Height of stem (HTS)                     =    12.00 ft
  Thickness top of stem (TTS)              =     1.17 ft
  Thickness bottom of stem (TBS)           =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.50 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.50 ft
  Width of toe (TWIDTH)                    =     2.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    10.50 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    516.50
       .00    518.00
      7.33    518.00
      7.33    530.00
      8.50    530.00
      8.50    518.00
     10.50    518.00
     10.50    516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1492.67	530.00
2	7.33	530.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	10.50	516.50
2	510.50	516.50

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 = 516.51 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 *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 ***
* Overturning *     Required base in comp. =  75.00 %
***************     Actual base in comp.   = 100.00 %
                    Overturning ratio      =   1.78

Xr (measured from toe) =   3.64 ft
Resultant ratio        =  .3463
Stem ratio             =  .1905
Base pressure at heel =     .0902 ksf
Base pressure at toe  =    2.2342 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.33
***********    Actual FS     =   1.84
```

```
********************** Output Results **********************

Date: **/11/14                                Time: 13.38.09

Flood Wall Stability Analysis Using CTWALL
Filename: I4CSLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          =    .0000
Calculated earth pressure coefficients:
  Driving side at rest K    =    .0000
  Driving side at rest Kc   =    .0000
  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 =    13.50 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       516.50      .8438

  Surcharge pressures:
       Elev.   Press.
       (ft)    (ksf)
    ===================

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
516.51	.0000
516.50	.0006
516.50	.0006

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.8438
10.50	.0006

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	4.469		-3.99	-17.85
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	11.435		-6.84	-78.16
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.733		-6.84	-5.01
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......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		5.695	4.50	25.63
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	2.17	.00
Foundation:				
Vertical force on base.....	-12.203		-3.64	44.37
Shear on base..............		-5.695	.00	.00
Uplift.....................	-4.433		-7.00	31.02
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base         =      .00 degrees
Normal force on base =   12.203 kips
Shear force on base  =    5.695 kips
Max. available shear force =   10.500 kips

Base pressure at heel =    .0902 ksf
Base pressure at toe  =   2.2342 ksf

Xr (measured from toe) =     3.64 ft
Resultant ratio         =    .3463
Stem ratio              =    .1905
Base in compression     =   100.00 %
Overturning ratio       =     1.78

Volume of concrete =     1.10 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	.000
2	5.695	.733
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0000		
2			.0000	.8438
2			10.5000	.0006
3	.0000	.0000		

Points of sliding plane:
Point 1 (left), x =   .00 ft,   y =   516.50 ft
Point 2 (right), x =   10.50 ft,   y =   516.50 ft

Depth of cracking =   13.50 ft
Crack extends to bottom of base of structure.

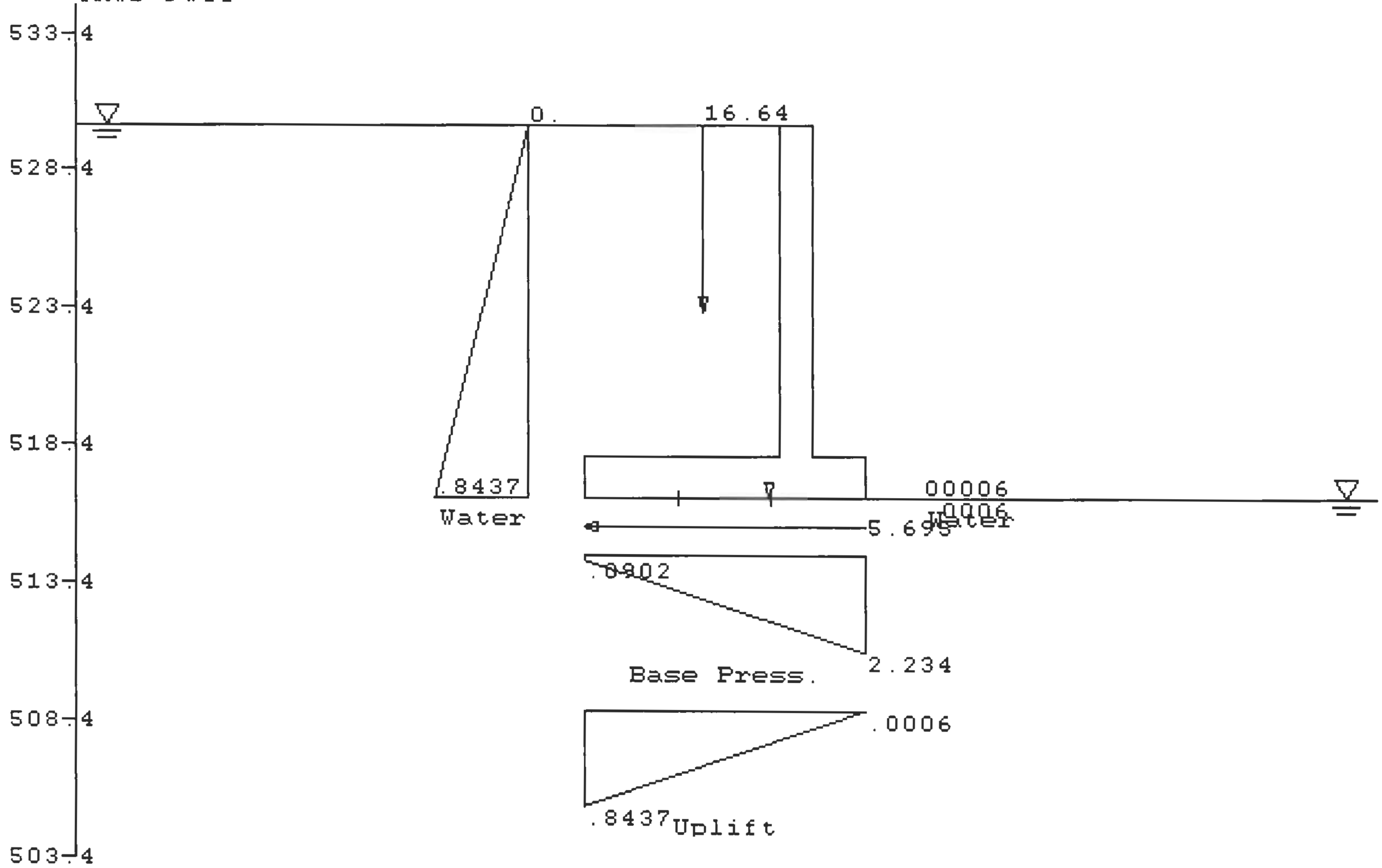
Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	.000	.000	.000	.000	.000
2	.000	10.500	15.903	10.500	4.433
3	.000	.000	.000	.000	.000

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

============

```
=======
          SUM =      .000

      +------------------------------+
      | Factor of safety =    1.844 |
      +------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Lower Level Retaining Walls: I4CLLL

Construction / Maintenance condition

1. Long-term soil properties assumed
2. Hydrostatic pressure to El 530 on driving side
3. Water at base of wall on resisting side
4. Passive soil pressure neglected on resisting side
5. 100 psf vertical surcharge pressure applied

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

Date: **/11/14 Time: 13.51.29

Flood Wall Stability Analysis Using CTWALL
Filename: I4CLLL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

Structural geometry data:

Elevation of top of stem (ELTS)	=	530.00	ft
Height of stem (HTS)	=	12.00	ft
Thickness top of stem (TTS)	=	1.17	ft
Thickness bottom of stem (TBS)	=	1.17	ft
Dist. of batter at bot. of stem (TBSR)	=	.00	ft
Depth of heel (THEEL)	=	1.50	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	1.50	ft
Width of toe (TWIDTH)	=	2.00	ft
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	12.50	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	516.50
.00	518.00
9.33	518.00
9.33	530.00
10.50	530.00
10.50	518.00
12.50	518.00
12.50	516.50

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	530.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1490.67	530.00
2	9.33	530.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	516.50	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	12.50	516.50
2	512.50	516.50

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 = 516.51 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

***************    *** Satisfied ***
* Overturning *    Required base in comp. =  75.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.44

Xr (measured from toe) =   4.77 ft
Resultant ratio        =  .3814
Stem ratio             =  .1600
Base pressure at heel =     .4118 ksf
Base pressure at toe  =    2.4466 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.33
***********    Actual FS     =   1.34
```

```
********************** Output Results **********************

Date: **/11/14                                   Time: 13.51.29

Flood Wall Stability Analysis Using CTWALL
Filename: I4CLLL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4285
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  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
       516.50      .4060

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.00      .0000
       516.50      .6924
```

Surcharge pressures:

Elev. (ft)	Press. (ksf)
530.00	.051
516.50	.051

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
516.51	.0000
516.50	.0006
516.50	.0006

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.4060
12.50	.0006

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	4.919		-4.68	-23.02
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	14.555		-7.83	-114.04
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.933		-7.84	-7.31
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......		4.674	4.50	21.03
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.693	6.75	4.68
Water loads................		2.740	4.50	12.34
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	2.33	.00
Foundation:				
Vertical force on base.....	-17.865		-4.77	85.16
Shear on base..............		-8.107	.00	.00
Uplift.....................	-2.541		-8.33	21.16
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 17.865 kips
Shear force on base = 8.107 kips
Max. available shear force = 10.353 kips

Base pressure at heel = .4118 ksf
Base pressure at toe = 2.4466 ksf

Xr (measured from toe) = 4.77 ft
Resultant ratio = .3814
Stem ratio = .1600
Base in compression = 100.00 %
Overturning ratio = 2.44

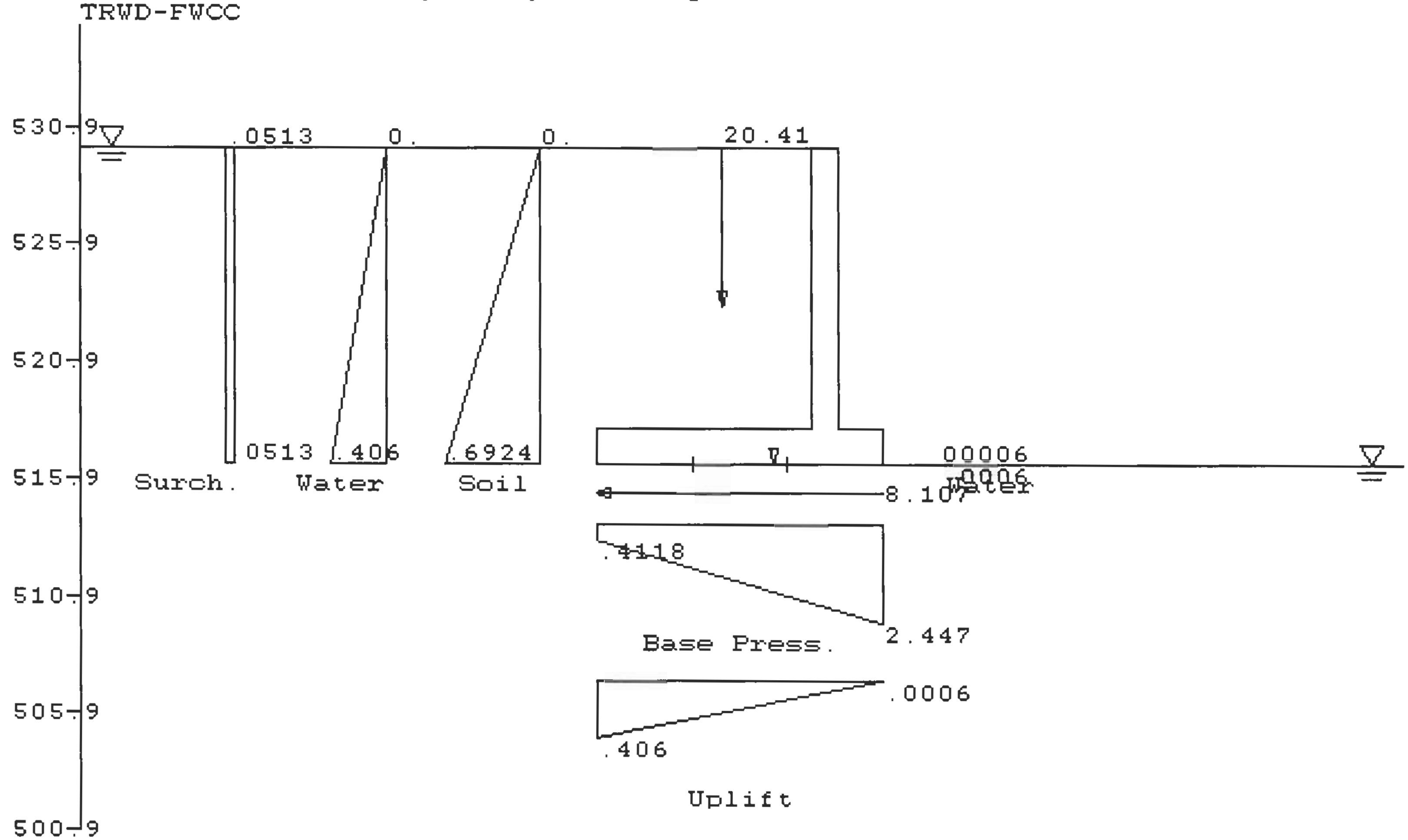
Volume of concrete = 1.21 cubic yds/ft of wall

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         .930
     2         .000         .933
     3         .000         .000

  Water pressures on wedges:

              Top       Bottom
    Wedge    press.    press.    x-coord.     press.
    number   (ksf)     (ksf)      (ft)        (ksf)
  ================================================
      1     .0000     .4060
      2                            .0000      .4060
      2                          12.5000      .0006
      3     .0000     .0000

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   516.50 ft
  Point 2 (right), x =    12.50 ft,   y =   516.50 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   -55.437   16.393     8.161   16.393      3.328
     2      .000   12.500    19.473   12.500      2.541
     3      .000     .000      .000     .000       .000

  Wedge     Net force
  number     (kips)
  ===================
     1       -7.717
     2        7.716
     3         .000
  ===================
     SUM =    -.001

+------------------------------+
| Factor of saf
```

```
ety =     1.342 |
      +-----------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Section 2
Mid - Level Retaining Walls -
Computer Runs for the Retaining Walls

Mid-Level Retaining Walls: I1NLML
Normal condition

1. Long-term soil properties assumed

2. Drained soil above drainage pipe on driving side

3. Passive soil pressure included on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14                                  Time: 13.44.38

Flood Wall Stability Analysis Using CTWALL
Filename: I1NLML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)        =   540.00 ft
  Height of stem (HTS)                   =    11.50 ft
  Thickness top of stem (TTS)            =     1.17 ft
  Thickness bottom of stem (TBS)         =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=       .00 ft
  Depth of heel (THEEL)                  =     1.50 ft
  Distance of batter for heel (BTRH)     =      .00 ft
  Depth of toe (TTOE)                    =     1.50 ft
  Width of toe (TWIDTH)                  =     2.00 ft
  Distance of batter for toe (BTRT)      =      .00 ft
  Width of base (BWIDTH)                 =    10.00 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    527.00
       .00    528.50
      6.83    528.50
      6.83    540.00
      8.00    540.00
      8.00    528.50
     10.00    528.50
     10.00    527.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	540.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1493.17	540.00
2	6.83	540.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	530.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	8.00	530.00
2	508.00	530.00

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 = 530.50 ft
Resisting side elevation = 527.01 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
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 ***
* Overturning *     Required base in comp. = 100.00 %
***************     Actual base in comp.   = 100.00 %
                    Overturning ratio      =   2.93

Xr (measured from toe) =   3.94 ft
Resultant ratio        =  .3935
Stem ratio             =  .2000
Base pressure at heel =     .4341 ksf
Base pressure at toe  =    1.9694 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   1.72
```

```
********************** Output Results **********************

Date: **/11/14                                      Time: 13.44.38

Flood Wall Stability Analysis Using CTWALL
Filename: I1NLML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.5245
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  Resisting side at rest K  =   2.6629
  Resisting side at rest Kc =   1.6319
  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)
    ======================
       530.50      .0000
       527.00      .1622

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       540.00      .0000
       530.50      .4876
       527.00      .6379

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
527.01	.0000
527.00	.0008

Earth pressures:

Elevation (ft)	Pressure (ksf)
530.00	.0000
527.00	.3988

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.1622
10.00	.0008

** Forces and moments **

Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	4.268		-3.86	-16.47
Structure, driving side:				
Moist soil................	6.489		-6.59	-42.73
Saturated soil............	1.776		-6.58	-11.69
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................	.300		-1.00	-.30
Saturated soil............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil..........	.000		.00	.00
Driving side:				
Effective earth loads......		4.286	4.37	18.74
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads...............		.284	1.17	.33
Resisting side:				
Effective earth loads......		-.598	1.00	-.60
Water loads...............		.000	.55	.00
Foundation:				
Vertical force on base.....	-12.017		-3.94	47.29
Shear on base.............		-3.971	.00	.00
Uplift....................	-.815		-6.65	5.42
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 12.017 kips
Shear force on base = 3.971 kips
Max. available shear force = 7.123 kips

Base pressure at heel = .4341 ksf
Base pressure at toe = 1.9694 ksf

Xr (measured from toe) = 3.94 ft
Resultant ratio = .3935
Stem ratio = .2000
Base in compression = 100.00 %
Overturning ratio = 2.93

Volume of concrete = 1.05 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	.000
2	.000	.000
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.1622		
2			.0000	.1622
2			10.0000	.0008
3	.0000	.0008		

Points of sliding plane:
Point 1 (left), x =   .00 ft,   y =   527.00 ft
Point 2 (right), x =   10.00 ft,   y =   527.00 ft

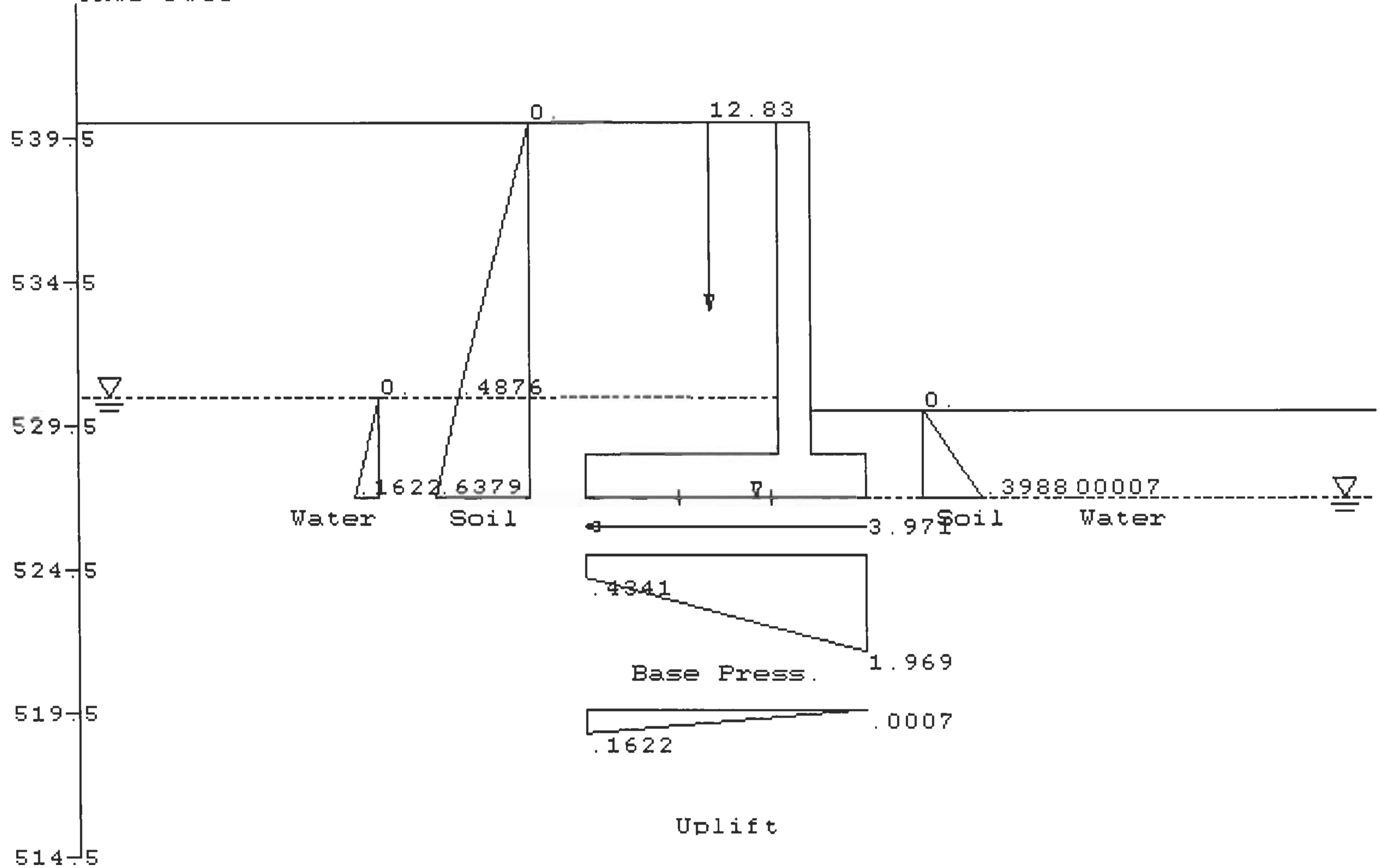
Depth of cracking =   .00 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	-53.386	16.196	6.415	4.360	.354
2	.000	10.000	12.833	10.000	.815
3	36.912	4.995	.599	.017	.000

Wedge number	Net force (kips)
1	-4.943
2	4.136
3	.807
SUM =	.000

```
+-----------------------------+
| Factor of safety =    1.722 |
+-----------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Mid-Level Retaining Walls: I1FLML

Flood / Drawdown condition

1. Long-term soil properties assumed

2. Hydrostatic pressure to El 535.5 on driving side

3. Water at El 531 on resisting side

4. Passive soil pressure included on resisting side

5. No surcharge pressure applied

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

Date: **/11/14                                      Time: 13.55.26

Flood Wall Stability Analysis Using CTWALL
Filename: I1FLML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)         =   540.00 ft
  Height of stem (HTS)                    =    11.50 ft
  Thickness top of stem (TTS)             =     1.17 ft
  Thickness bottom of stem (TBS)          =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=        .00 ft
  Depth of heel (THEEL)                   =     1.50 ft
  Distance of batter for heel (BTRH)      =      .00 ft
  Depth of toe (TTOE)                     =     1.50 ft
  Width of toe (TWIDTH)                   =     2.00 ft
  Distance of batter for toe (BTRT)       =      .00 ft
  Width of base (BWIDTH)                  =    11.50 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    527.00
       .00    528.50
      8.33    528.50
      8.33    540.00
      9.50    540.00
      9.50    528.50
     11.50    528.50
     11.50    527.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	540.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1491.67	540.00
2	8.33	540.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	530.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	9.50	530.00
2	509.50	530.00

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 = 535.50 ft
Resisting side elevation = 531.00 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.18

Xr (measured from toe) =   4.60 ft
Resultant ratio        =  .3996
Stem ratio             =  .1739
Base pressure at heel =     .4271 ksf
Base pressure at toe  =    1.7197 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   1.54
```

********************* Output Results *********************

Date: **/11/14 Time: 13.55.26

Flood Wall Stability Analysis Using CTWALL
Filename: I1FLML.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

****
** Overturning Results **
****

Solution converged in 1 iterations.

SMF used to calculate K's = .6667
Alpha for the SMF = -54.5386
Calculated earth pressure coefficients:
Driving side at rest K = .5133
Driving side at rest Kc = .7164
Resisting side at rest K = 2.6629
Resisting side at rest Kc = 1.6319
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 (ft)	Pressure (ksf)
535.50	.0000
527.00	.4273

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
535.50	.2310
527.00	.5788

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
531.00	.0000
530.00	.0625
527.00	.2867

Earth pressures:

Elevation (ft)	Pressure (ksf)
530.00	.0000
527.00	.2208

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.4273
11.50	.2867

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	4.606		-4.36	-20.09
Structure, driving side:				
Moist soil................	3.748		-7.34	-27.50
Saturated soil............	7.580		-7.33	-55.60
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............	.390		-1.00	-.39
Water above structure......	.000		.00	.00
Water above soil..........	.125		-1.00	-.13
Driving side:				
Effective earth loads......		3.961	4.47	17.72
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads...............		1.816	2.83	5.15
Resisting side:				
Effective earth loads......		-.331	1.00	-.33
Water loads...............		-.555	1.30	-.72
Foundation:				
Vertical force on base.....	-12.344		-4.60	56.73
Shear on base.............		-4.891	.00	.00
Uplift....................	-4.105		-6.13	25.16
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 12.344 kips
Shear force on base = 4.891 kips
Max. available shear force = 7.440 kips

Base pressure at heel = .4271 ksf
Base pressure at toe = 1.7197 ksf

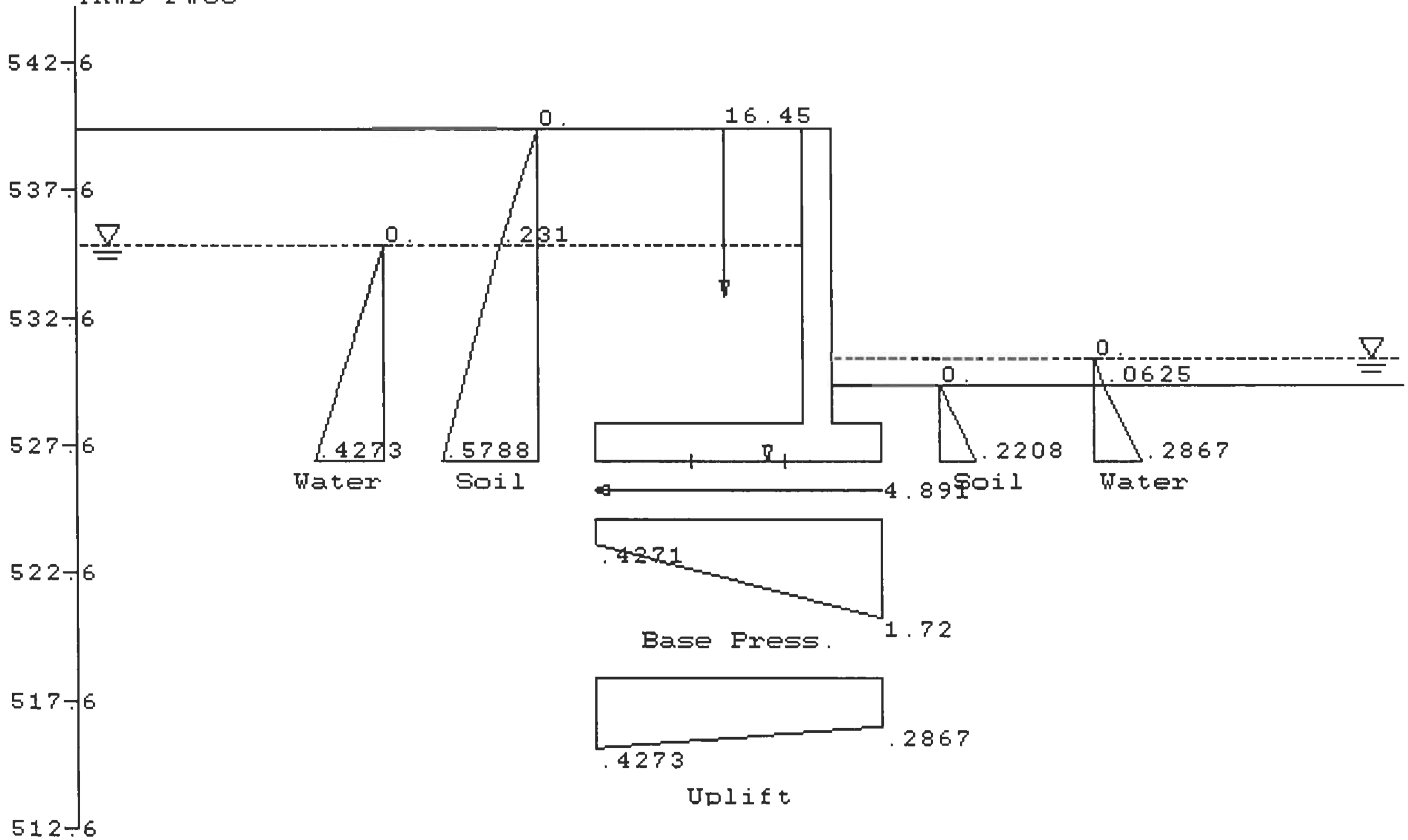
Xr (measured from toe) = 4.60 ft
Resultant ratio = .3996
Stem ratio = .1739
Base in compression = 100.00 %
Overturning ratio = 2.18

Volume of concrete = 1.14 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        -.031         .125
     3         .000         .259

  Water pressures on wedges:

             Top       Bottom
    Wedge    press.    press.    x-coord.     press.
    number   (ksf)     (ksf)      (ft)        (ksf)
  ================================================
      1     .0000     .4273
      2                            .0000       .4273
      2                          11.5000       .2867
      3     .0625     .2867

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   527.00 ft
  Point 2 (right), x =    11.50 ft,   y =   527.00 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   -54.301    16.008      6.851    10.467      2.236
     2      .000    11.500     16.325    11.500      4.105
     3    35.908     5.115       .808     5.115       .893

  Wedge     Net force
  number     (kips)
  ===================
     1       -5.850
     2        4.851
     3        1.000
  ===================
     SUM =     .000

+-----------------------------+
| Factor of safety =    1.544 |
+----------
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Mid-Level Retaining Walls: I1FSML

Flood / Drawdown condition

1. Short-term soil properties assumed – “Study” case
2. Full-depth water filled crack on driving side
3. Water at El 531 on resisting side
4. Passive soil pressure included on resisting side
5. No surcharge pressure applied

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

Date: **/11/14                              Time: 14.05.31

Flood Wall Stability Analysis Using CTWALL
Filename: I1FSML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)        =   540.00 ft
  Height of stem (HTS)                   =    11.50 ft
  Thickness top of stem (TTS)            =     1.17 ft
  Thickness bottom of stem (TBS)         =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=      .00 ft
  Depth of heel (THEEL)                  =     1.50 ft
  Distance of batter for heel (BTRH)     =      .00 ft
  Depth of toe (TTOE)                    =     1.50 ft
  Width of toe (TWIDTH)                  =     2.00 ft
  Distance of batter for toe (BTRT)      =      .00 ft
  Width of base (BWIDTH)                 =     7.50 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    527.00
       .00    528.50
      4.33    528.50
      4.33    540.00
      5.50    540.00
      5.50    528.50
      7.50    528.50
      7.50    527.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	540.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1495.67	540.00
2	4.33	540.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	530.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	5.50	530.00
2	505.50	530.00

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 = 535.50 ft
- Resisting side elevation = 531.00 ft
- Unit weight of water = .0625 kcf
- Seepage pressures computed by Line of Creep method.

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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.74

Xr (measured from toe) =   2.54 ft
Resultant ratio        =  .3383
Stem ratio             =  .2667
Base pressure at heel =     .0305 ksf
Base pressure at toe  =    2.0047 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   3.02
```

```
********************** Output Results **********************

Date: **/11/14                                  Time: 14.05.31

Flood Wall Stability Analysis Using CTWALL
Filename: I1FSML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

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

Depth of cracking =    13.00 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       540.00      .0000
       527.00      .5313

** Resisting side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       531.00      .0000
       530.00      .0625
       527.00      .1295
```

Earth pressures:

Elevation (ft)	Pressure (ksf)
530.00	.0000
527.00	1.0209

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.5313
7.50	.1295

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	3.706		-3.12	-11.55
Structure, driving side:				
Moist soil.................	1.949		-5.33	-10.40
Saturated soil.............	3.940		-5.33	-21.02
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.............	.390		-1.00	-.39
Water above structure......	.000		.00	.00
Water above soil...........	.125		-1.00	-.13
Driving side:				
Effective earth loads......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		3.453	4.33	14.96
Resisting side:				
Effective earth loads......		-1.531	1.00	-1.54
Water loads................		-.319	1.52	-.49
Foundation:				
Vertical force on base.....	-7.632		-2.54	19.37
Shear on base..............		-1.603	.00	.00
Uplift.....................	-2.478		-4.51	11.17
** Statics Check ** SUMS =	.000	.000		.00

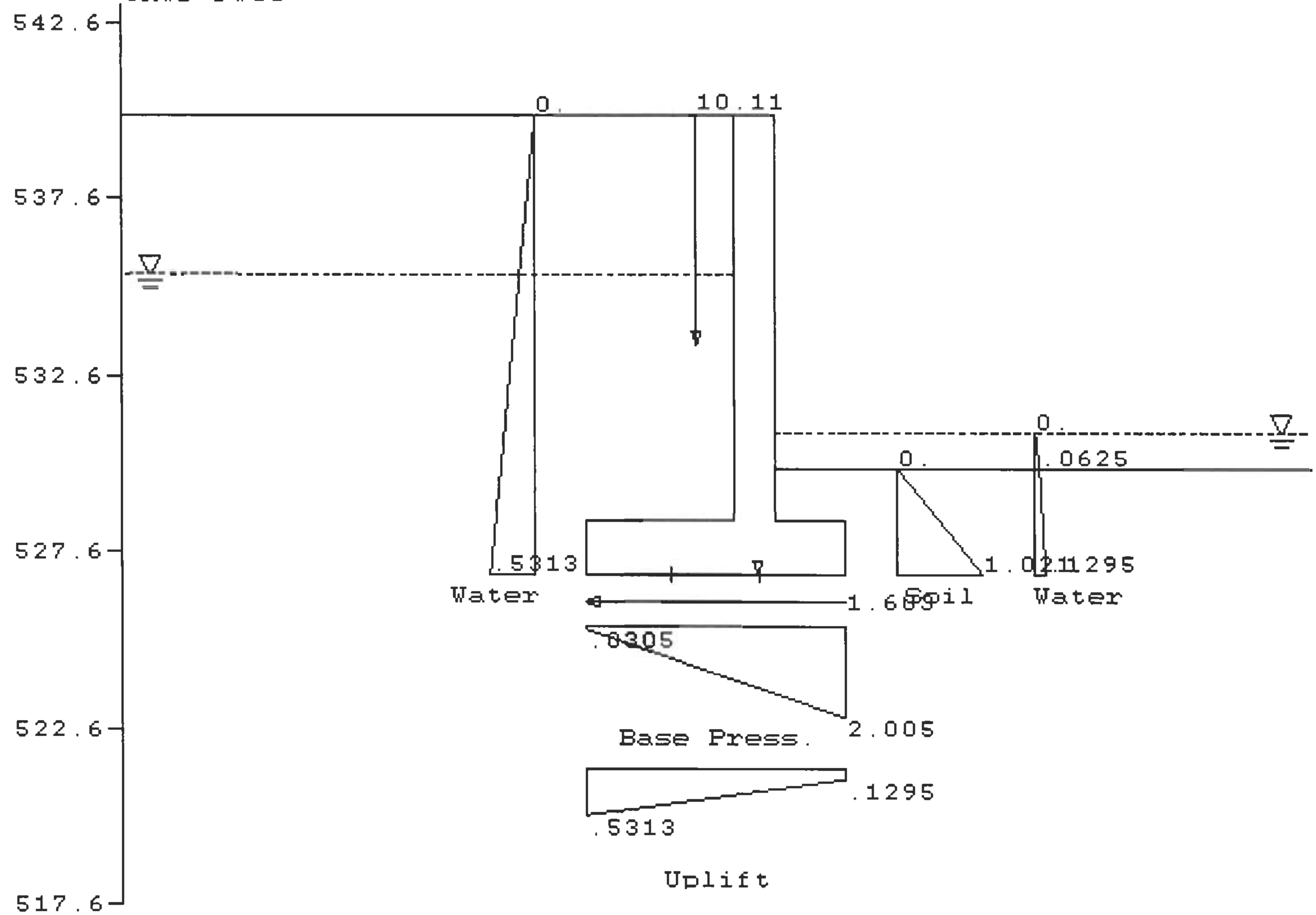
```
Angle of base          =       .00 degrees
Normal force on base =    7.632 kips
Shear force on base  =    1.603 kips
Max. available shear force =    7.500 kips

Base pressure at heel =    .0305 ksf
Base pressure at toe  =   2.0047 ksf

Xr (measured from toe) =     2.54 ft
Resultant ratio         =    .3383
Stem ratio              =    .2667
Base in compression     =   100.00 %
Overturning ratio       =     1.74

Volume of concrete =      .92 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       5.250        .125
     3        .000        .187

  Water pressures on wedges:

             Top      Bottom
    Wedge    press.   press.   x-coord.    press.
    number   (ksf)    (ksf)     (ft)       (ksf)
  ================================================
      1     .0000     .0000
      2                          .0000      .5313
      2                         7.5000      .1295
      3     .0625     .1295

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   527.00 ft
  Point 2 (right), x =     7.50 ft,   y =   527.00 ft

Depth of cracking =    13.00 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     7.500      9.985     7.500      2.478
     3    45.036     4.240       .584     4.240       .407

  Wedge     Net force
  number     (kips)
  ==================
     1         .000
     2       -2.762
     3        2.763
  ==================
```

```
SUM =       .000

+-------------------------------+
| Factor of safety =     3.015  |
+-------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Mid-Level Retaining Walls: I3ELML

Earthquake condition

1. Long-term soil properties assumed

2. Drained soil above drainage pipe on driving side

3. Passive soil pressure included on resisting side

4. No surcharge pressure

5. Lateral seismic forces accounted for

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

Date: **/11/16                                    Time: 10.18.38

Flood Wall Stability Analysis Using CTWALL
Filename: I3ELML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   540.00 ft
  Height of stem (HTS)                     =    11.50 ft
  Thickness top of stem (TTS)              =     1.17 ft
  Thickness bottom of stem (TBS)           =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.50 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.50 ft
  Width of toe (TWIDTH)                    =     1.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    11.50 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    527.00
      .00    528.50
     9.33    528.50
     9.33    540.00
    10.50    540.00
    10.50    528.50
    11.50    528.50
    11.50    527.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.100	.100	.130	.00	540.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1490.67	540.00
2	9.33	540.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.100	.100	.130	530.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	10.50	530.00
2	510.50	530.00

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 = 530.50 ft
- Resisting side elevation = 527.10 ft
- Unit weight of water = .0625 kcf
- Seepage pressures computed by Line of Creep method.

```
Minimum required factors of safety:
  Sliding FS    =    1.10
  Overturning   =     .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.
```

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

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

***************     *** Satisfied ***
* Overturning *     Required base in comp. =     .10 %
***************     Actual base in comp.   = 100.00 %
                    Overturning ratio      =   4.17

Xr (measured from toe) =   4.86 ft
Resultant ratio        =  .4228
Stem ratio             =  .0870
Base pressure at heel =     .7016 ksf
Base pressure at toe  =    1.9117 ksf

***********     *** Satisfied ***
* Sliding *     Min. Required =   1.10
***********     Actual FS     =   2.36
```

```
********************** Output Results **********************

Date: **/11/16                                         Time: 10.18.38

Flood Wall Stability Analysis Using CTWALL
Filename: I3ELML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          = -52.7738
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5127
  Driving side at rest Kc   =    .7173
  Resisting side at rest K  =   2.6629
  Resisting side at rest Kc =   1.6319
  Full passive K calculated for resisting side.
  50% of full passive will be used.

Depth of cracking =     -.88 ft

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       530.50      .0000
       527.00      .1695

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       540.88      .0000
       540.00      .0000
       530.50      .3914
       527.00      .5378

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
527.10	.0000
527.00	.0077

Earth pressures:

Elevation (ft)	Pressure (ksf)
530.00	.0000
527.00	.5564

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.1695
11.50	.0077

** Forces and moments **

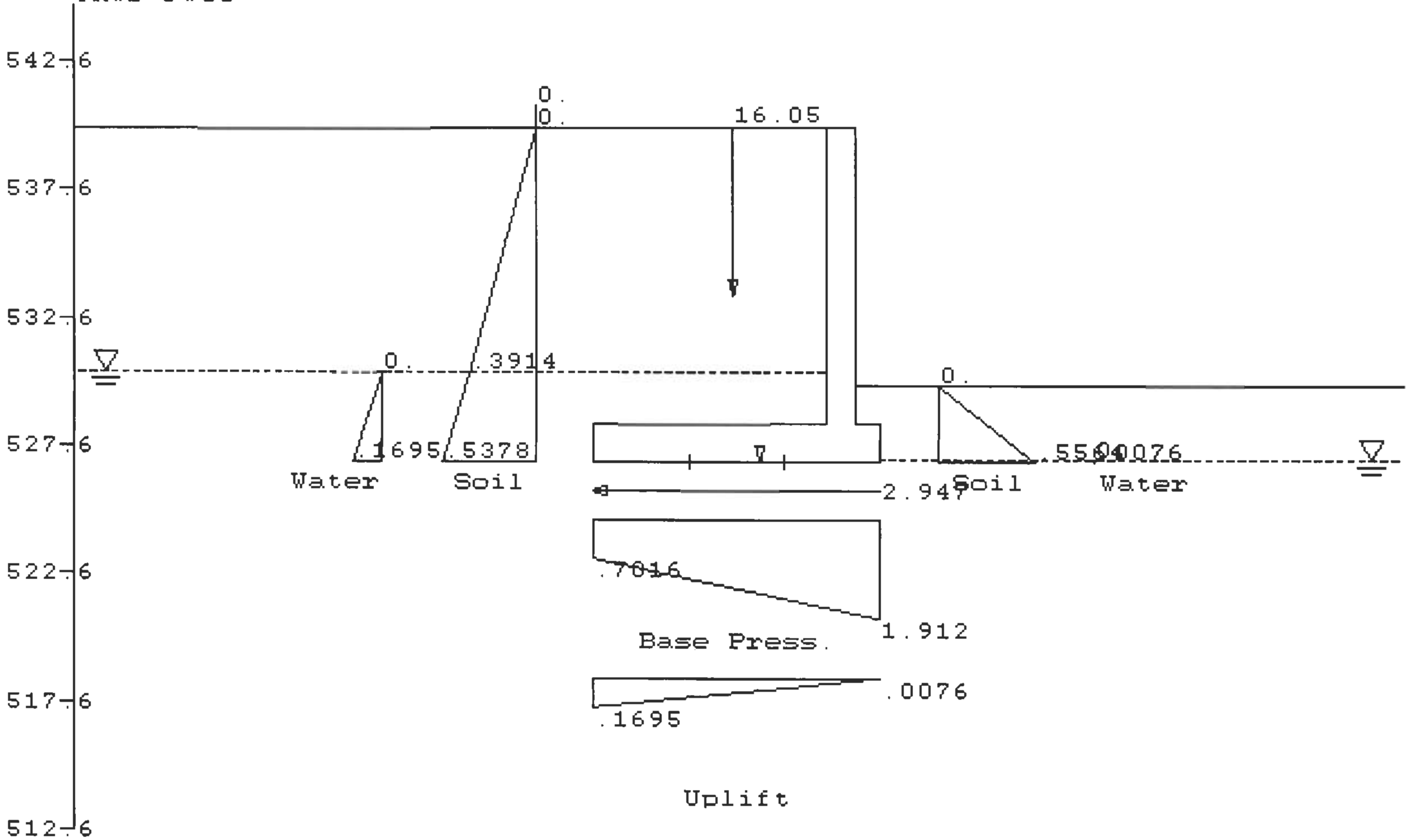
Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	4.606		-3.92	-18.08
Structure, driving side:				
Moist soil.................	8.864		-6.84	-60.58
Saturated soil.............	2.426		-6.84	-16.58
Water above structure......	.000		.00	.00
Water above 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.................	.150		-.50	-.08
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
Driving side:				
Effective earth loads......		3.485	4.33	15.10
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		.297	1.17	.35
Resisting side:				
Effective earth loads......		-.835	1.00	-.84
Water loads................		.000	.24	.00
Foundation:				
Vertical force on base.....	-15.026		-4.86	73.07
Shear on base..............		-2.947	.00	.00
Uplift.....................	-1.019		-7.50	7.64
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base          =      .00 degrees
Normal force on base =   15.026 kips
Shear force on base  =    2.947 kips
Max. available shear force =    8.806 kips

Base pressure at heel =    .7016 ksf
Base pressure at toe  =   1.9117 ksf

Xr (measured from toe) =     4.86 ft
Resultant ratio         =    .4228
Stem ratio              =    .0870
Base in compression     =   100.00 %
Overturning ratio       =     4.17

Volume of concrete =     1.14 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        .000        .000
     3        .000        .000

  Water pressures on wedges:

             Top       Bottom
    Wedge   press.    press.    x-coord.     press.
    number  (ksf)     (ksf)      (ft)        (ksf)
  ================================================
      1     .0000     .1695
      2                            .0000      .1695
      2                          11.5000      .0077
      3     .0000     .0077

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   527.00 ft
  Point 2 (right), x =    11.50 ft,   y =   527.00 ft

Depth of cracking =     -.96 ft

          Failure   Total    Weight    Submerged   Uplift
  Wedge    angle    length  of wedge    length     force
  number   (deg)     (ft)    (kips)      (ft)      (kips)
  =======================================================
     1   -48.736   18.567     7.535    4.656       .395
     2      .000   11.500    16.045   11.500      1.019
     3    39.143    4.752      .553     .158       .001

  Wedge     Net force
  number     (kips)
  ===================
     1       -4.735
     2        3.729
     3        1.005
  ===================
     SUM =     .000

+------------------------------+
| Factor of safety =    2.361 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Mid-Level Retaining Walls: I4CSML

Construction condition

1. Short-term soil properties assumed

2. Fully drained soil on driving side

3. Passive soil pressure neglected on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14                                    Time: 14.20.21

Flood Wall Stability Analysis Using CTWALL
Filename: I4CSML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   540.00 ft
  Height of stem (HTS)                     =    11.50 ft
  Thickness top of stem (TTS)              =     1.17 ft
  Thickness bottom of stem (TBS)           =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.50 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.50 ft
  Width of toe (TWIDTH)                    =     2.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    10.00 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    527.00
       .00    528.50
      6.83    528.50
      6.83    540.00
      8.00    540.00
      8.00    528.50
     10.00    528.50
     10.00    527.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	540.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1493.17	540.00
2	6.83	540.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	527.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	10.00	527.00
2	510.00	527.00

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 = 540.00 ft
  Resisting side elevation = 527.01 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 *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 ***
* Overturning *    Required base in comp. =  75.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.76

Xr (measured from toe) =   3.44 ft
Resultant ratio        =  .3445
Stem ratio             =  .2000
Base pressure at heel  =     .0743 ksf
Base pressure at toe   =    2.1450 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.33
***********    Actual FS     =   1.89
```

```
********************** Output Results **********************

Date: **/11/14                                  Time: 14.20.21

Flood Wall Stability Analysis Using CTWALL
Filename: I4CSML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          =     .0000
Calculated earth pressure coefficients:
  Driving side at rest K    =     .0000
  Driving side at rest Kc   =     .0000
  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 =    13.00 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       540.00      .0000
       527.00      .8125

  Surcharge pressures:
       Elev.   Press.
       (ft)    (ksf)
    ===================

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
527.01	.0000
527.00	.0006
527.00	.0006

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.8125
10.00	.0006

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	4.268		-3.86	-16.47
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	10.211		-6.58	-67.24
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.683		-6.59	-4.50
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......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		5.281	4.33	22.88
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	.70	.00
Foundation:				
Vertical force on base.....	-11.096		-3.44	38.23
Shear on base..............		-5.281	.00	.00
Uplift.....................	-4.066		-6.66	27.09
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base          =       .00 degrees
Normal force on base =   11.096 kips
Shear force on base  =    5.281 kips
Max. available shear force =   10.000 kips

Base pressure at heel =    .0743 ksf
Base pressure at toe  =   2.1450 ksf

Xr (measured from toe) =     3.44 ft
Resultant ratio         =    .3445
Stem ratio              =    .2000
Base in compression     =   100.00 %
Overturning ratio       =     1.76

Volume of concrete =     1.05 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	.000
2	5.281	.683
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0000		
2			.0000	.8125
2			10.0000	.0006
3	.0000	.0000		

Points of sliding plane:
  Point 1 (left), x =   .00 ft,   y =   527.00 ft
  Point 2 (right), x =   10.00 ft,   y =   527.00 ft

Depth of cracking =   13.00 ft
Crack extends to bottom of base of structure.

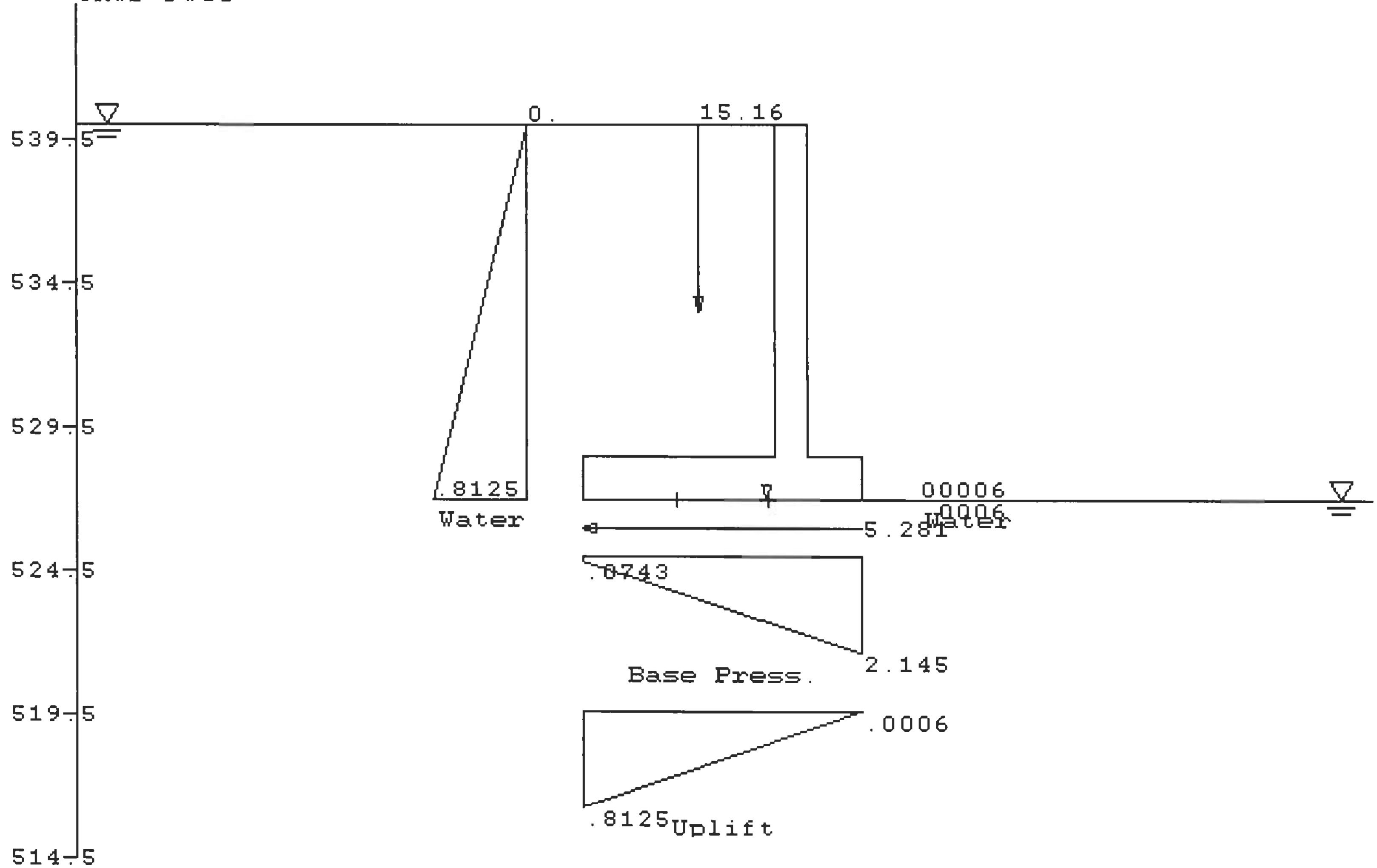
Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	.000	.000	.000	.000	.000
2	.000	10.000	14.479	10.000	4.066
3	.000	.000	.000	.000	.000

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

============

```
=======
          SUM =      .000

      +------------------------------+
      | Factor of safety =    1.893 |
      +------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Mid-Level Retaining Walls: I4CLML

Construction condition

1. Long-term soil properties assumed

2. Fully drained soil on driving side

3. Passive soil pressure neglected on resisting side

4. 100 psf vertical surcharge pressure applied

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

```
Date: **/11/14                                   Time: 14.07.57

Flood Wall Stability Analysis Using CTWALL
Filename: I4CLML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)         =   540.00 ft
  Height of stem (HTS)                    =    11.50 ft
  Thickness top of stem (TTS)             =     1.17 ft
  Thickness bottom of stem (TBS)          =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=        .00 ft
  Depth of heel (THEEL)                   =     1.50 ft
  Distance of batter for heel (BTRH)      =      .00 ft
  Depth of toe (TTOE)                     =     1.50 ft
  Width of toe (TWIDTH)                   =     2.00 ft
  Distance of batter for toe (BTRT)       =      .00 ft
  Width of base (BWIDTH)                  =     9.00 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    527.00
      .00    528.50
     5.83    528.50
     5.83    540.00
     7.00    540.00
     7.00    528.50
     9.00    528.50
     9.00    527.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	540.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1494.17	540.00
2	5.83	540.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	527.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	9.00	527.00
2	509.00	527.00

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 = 527.01 ft
  Resisting side elevation = 527.01 ft
  Unit weight of water = .0625 kcf
  Seepage pressures computed are hydrostatic.

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

***************    *** Satisfied ***
* Overturning *    Required base in comp. =  75.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.53

Xr (measured from toe) =   3.14 ft
Resultant ratio        =  .3486
Stem ratio             =  .2222
Base pressure at heel =     .1149 ksf
Base pressure at toe  =    2.4017 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.33
***********    Actual FS     =   1.40
```

```
********************** Output Results **********************

Date: **/11/14                                    Time: 14.07.57

Flood Wall Stability Analysis Using CTWALL
Filename: I4CLML.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF         = -54.5245
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  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)
    ======================
       527.01      .0000
       527.00      .0006

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       540.00      .0000
       527.01      .6667
       527.00      .6671
```

Surcharge pressures:

Elev. (ft)	Press. (ksf)
540.00	.051
527.00	.051

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
527.01	.0000
527.00	.0006
527.00	.0006

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.0006
9.00	.0006

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	4.043		-3.54	-14.33
Structure, driving side:				
Moist soil.................	6.704		-6.08	-40.80
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.583		-6.09	-3.55
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......		4.337	4.33	18.78
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.667	6.50	4.34
Water loads................		.000	-.37	.00
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	-.37	.00
Foundation:				
Vertical force on base.....	-11.325		-3.14	35.53
Shear on base..............		-5.004	.00	.00
Uplift.....................	-.006		-4.50	.03
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 11.325 kips
Shear force on base = 5.004 kips
Max. available shear force = 6.670 kips

Base pressure at heel = .1149 ksf
Base pressure at toe = 2.4017 ksf

Xr (measured from toe) = 3.14 ft
Resultant ratio = .3486
Stem ratio = .2222
Base in compression = 100.00 %
Overturning ratio = 2.53

Volume of concrete = 1.00 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	.910
2	.000	.583
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0006		
2			.0000	.0006
2			9.0000	.0006
3	.0000	.0000		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 527.00 ft
Point 2 (right), x = 9.00 ft, y = 527.00 ft

Depth of cracking = .00 ft

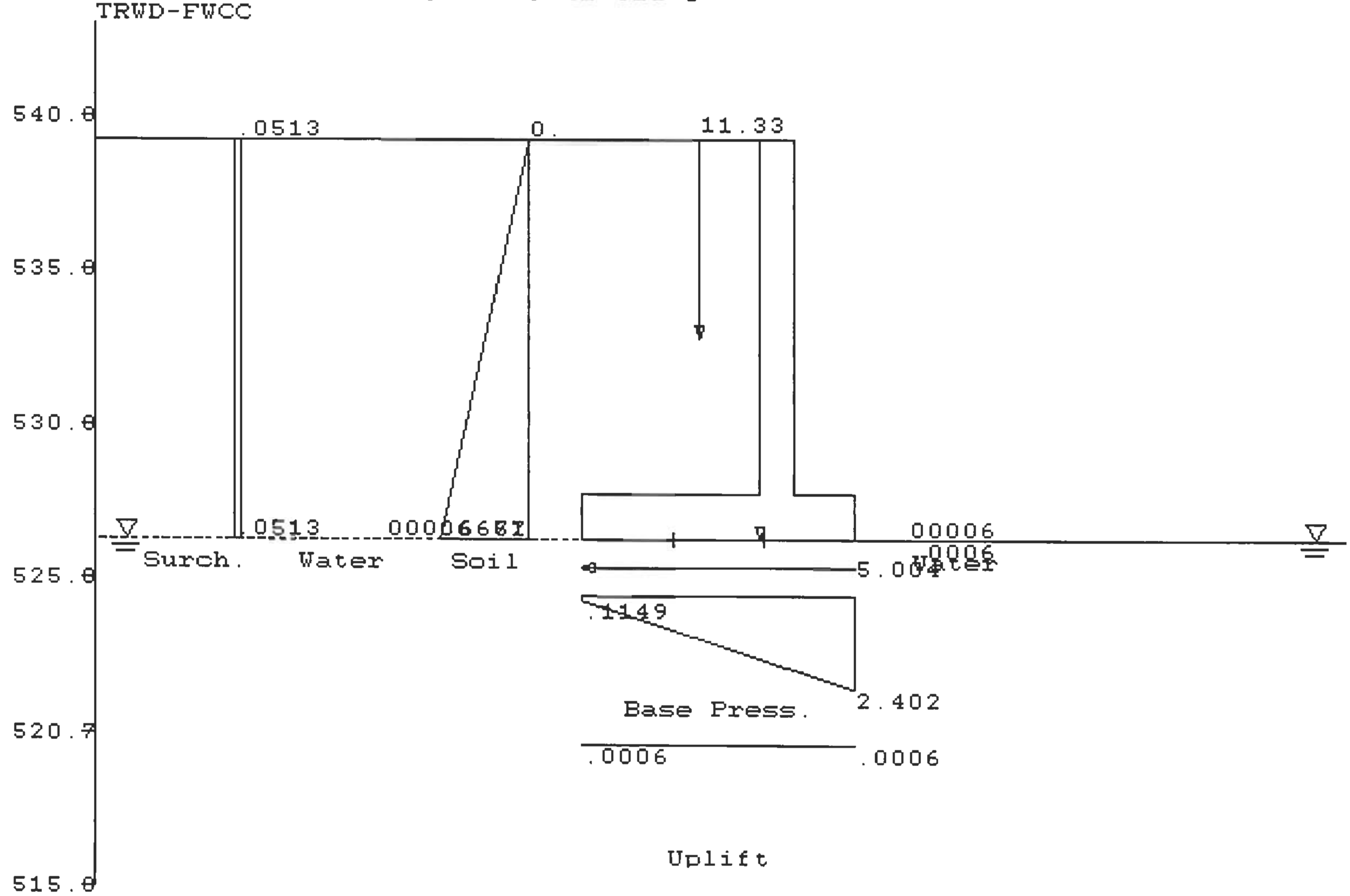
Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	-55.003	15.870	5.916	.012	.000
2	.000	9.000	10.748	9.000	.006
3	.000	.000	.000	.000	.000

Wedge number	Net force (kips)
1	-4.774
2	4.774
3	.000
SUM =	.000

+-----------------------------

```
+
        | Factor of safety =    1.397 |
        +-----------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Section 3
Upper Level Retaining Walls - Computer Runs for the Retaining Walls

Upper Level Retaining Walls: I1NL14UL

(14-ft clear height)

Normal condition

1. Long-term soil properties assumed

2. Drained soil above drainage pipe on driving side

3. Passive soil pressure included on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14                                   Time: 14.10.26

Flood Wall Stability Analysis Using CTWALL
Filename: I1NL14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   554.00 ft
  Height of stem (HTS)                     =    15.17 ft
  Thickness top of stem (TTS)              =     1.75 ft
  Thickness bottom of stem (TBS)           =     1.75 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.83 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.83 ft
  Width of toe (TWIDTH)                    =     4.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    16.00 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    537.00
      .00    538.83
    10.25    538.83
    10.25    554.00
    12.00    554.00
    12.00    538.83
    16.00    538.83
    16.00    537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	554.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1489.75	554.00
2	10.25	554.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	12.00	540.00
2	512.00	540.00

Foundation property data:
phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .250 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .250 (ksf)

Water data:
Driving side elevation = 540.50 ft
Resisting side elevation = 537.01 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    =    1.50
  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 ***
* Overturning *     Required base in comp. = 100.00 %
***************     Actual base in comp.   = 100.00 %
                    Overturning ratio      =   3.72

Xr (measured from toe) =   7.22 ft
Resultant ratio        =  .4513
Stem ratio             =  .2500
Base pressure at heel =    1.0831 ksf
Base pressure at toe  =    1.9777 ksf

***********     *** Satisfied ***
* Sliding *     Min. Required =   1.50
***********     Actual FS     =   1.86
```

```
********************** Output Results **********************

Date: **/11/14                                     Time: 14.10.26

Flood Wall Stability Analysis Using CTWALL
Filename: I1NL14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4205
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  Resisting side at rest K  =   2.6629
  Resisting side at rest Kc =   1.6319
  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)
    ======================
       540.50      .0000
       537.00      .1796

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       554.00      .0000
       540.50      .6929
       537.00      .8343
```

Surcharge pressures:

Elev. (ft)	Press. (ksf)
554.00	.051
537.00	.051

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
537.01	.0000
537.00	.0007

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	.3989

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.1796
16.00	.0007

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	8.374		-6.51	-54.55
Structure, driving side:				
Moist soil.................	13.838		-10.88	-150.48
Saturated soil.............	2.225		-10.87	-24.20
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	1.025		-10.88	-11.15
Ext. horz. pressure loads..		.000	.00	.00
Ext. horz. line loads......		.000	.00	.00
Structure, resisting side:				
Moist soil.................	.468		-2.00	-.94
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
Driving side:				
Effective earth loads......		7.350	5.71	41.96
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.873	8.50	7.42
Water loads................		.314	1.16	.37
Resisting side:				
Effective earth loads......		-.598	.99	-.59
Water loads................		.000	-.10	.00
Foundation:				
Vertical force on base.....	-24.487		-7.22	176.81
Shear on base..............		-7.938	.00	.00
Uplift.....................	-1.443		-10.64	15.36
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 24.487 kips
Shear force on base = 7.938 kips
Max. available shear force = 16.477 kips

Base pressure at heel = 1.0831 ksf
Base pressure at toe = 1.9777 ksf

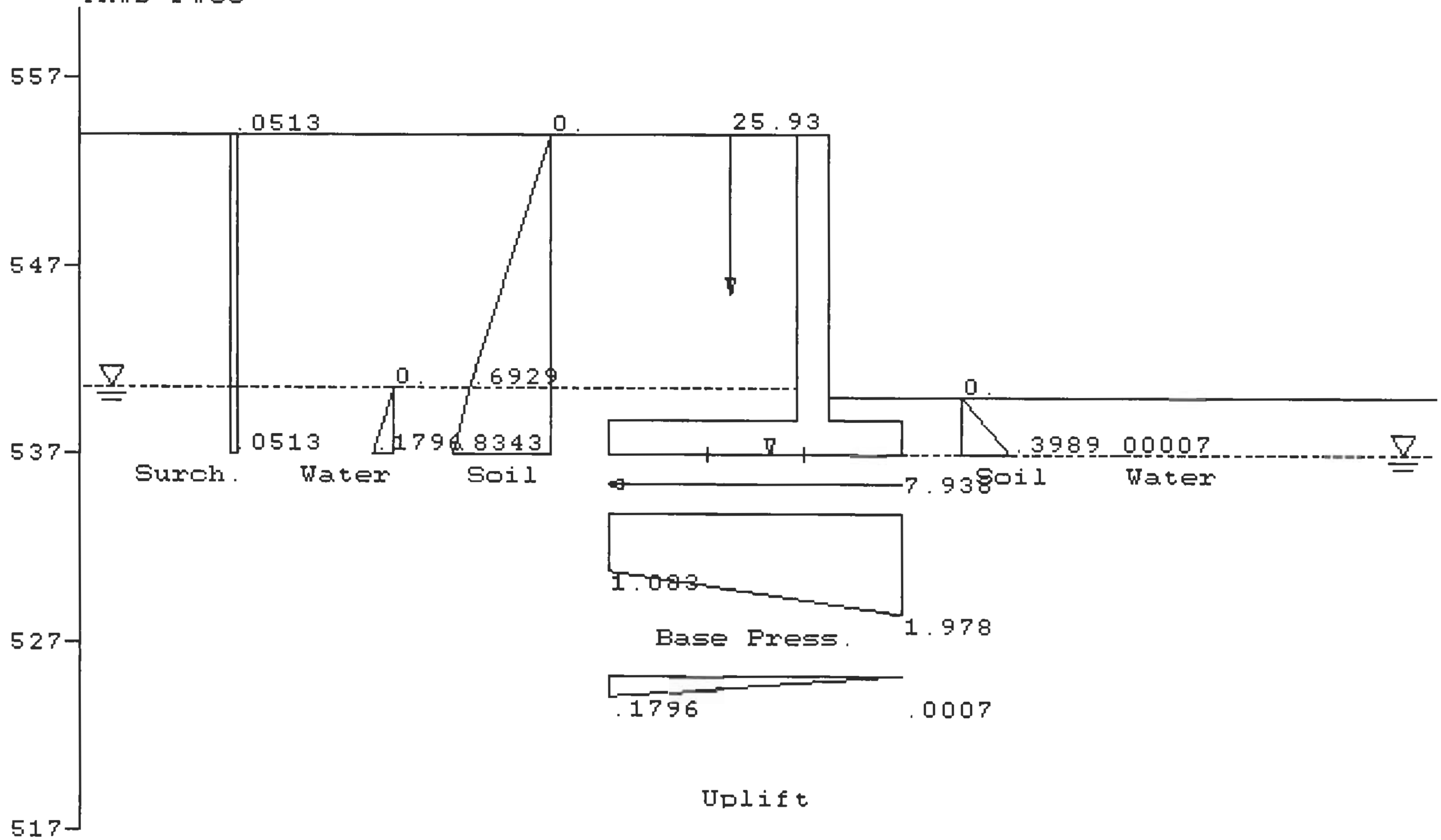
Xr (measured from toe) = 7.22 ft
Resultant ratio = .4513
Stem ratio = .2500
Base in compression = 100.00 %
Overturning ratio = 3.72

Volume of concrete = 2.07 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       1.295
     2         .000       1.025
     3         .000        .000

  Water pressures on wedges:

             Top      Bottom
    Wedge    press.   press.   x-coord.    press.
    number   (ksf)    (ksf)     (ft)       (ksf)
  =================================================
      1     .0000     .1796
      2                           .0000      .1796
      2                         16.0000      .0007
      3     .0000     .0007

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =    16.00 ft,   y =   537.00 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   -52.702    21.370     11.147     4.400       .395
     2      .000    16.000     24.905    16.000      1.443
     3    37.777     4.897       .581      .016       .000

  Wedge     Net force
  number     (kips)
  ===================
     1       -9.636
     2        8.863
     3         .773
  ===================
     SUM =     .000

+------------------------------+
| Factor of safety =    1.859 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I1FL14UL
(14-ft clear height)

Flood / Drawdown condition

1. Long-term soil properties assumed

2. Hydrostatic pressure to El 549 on driving side

3. Water at El 544 on resisting side

4. Passive soil pressure included on resisting side

5. No surcharge pressure applied

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

Date: **/11/14 Time: 14.29.12

Flood Wall Stability Analysis Using CTWALL
Filename: I1FL14UL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

Structural geometry data:

Elevation of top of stem (ELTS)	=	554.00	ft
Height of stem (HTS)	=	15.17	ft
Thickness top of stem (TTS)	=	1.75	ft
Thickness bottom of stem (TBS)	=	1.75	ft
Dist. of batter at bot. of stem (TBSR)	=	.00	ft
Depth of heel (THEEL)	=	1.83	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	1.83	ft
Width of toe (TWIDTH)	=	4.00	ft
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	14.50	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	537.00
.00	538.83
8.75	538.83
8.75	554.00
10.50	554.00
10.50	538.83
14.50	538.83
14.50	537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	554.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1491.25	554.00
2	8.75	554.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	10.50	540.00
2	510.50	540.00

Foundation property data:
phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .250 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .250 (ksf)

Water data:
Driving side elevation = 549.00 ft
Resisting side elevation = 544.00 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.91

Xr (measured from toe) =   5.86 ft
Resultant ratio        =  .4039
Stem ratio             =  .2759
Base pressure at heel =     .5134 ksf
Base pressure at toe  =    1.9136 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   1.51
```

```
********************** Output Results **********************

Date: **/11/14                                    Time: 14.29.12

Flood Wall Stability Analysis Using CTWALL
Filename: I1FL14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4202
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  Resisting side at rest K  =   2.6629
  Resisting side at rest Kc =   1.6319
  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)
    ======================
       549.00      .0000
       537.00      .6229

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       554.00      .0000
       549.00      .2566
       537.00      .7376

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
544.00	.0000
540.00	.2500
537.00	.4693

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	.2273

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.6229
14.50	.4693

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	7.962		-6.06	-48.27
Structure, driving side:				
Moist soil.................	4.375		-10.12	-44.30
Saturated soil.............	11.568		-10.12	-117.13
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.............	.608		-2.00	-1.22
Water above structure......	.000		.00	.00
Water above soil...........	1.000		-2.00	-2.00
Driving side:				
Effective earth loads......		6.607	5.87	38.79
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		3.737	4.00	14.95
Resisting side:				
Effective earth loads......		-.341	1.00	-.34
Water loads................		-1.579	2.29	-3.62
Foundation:				
Vertical force on base.....	-17.596		-5.86	103.04
Shear on base..............		-8.425	.00	.00
Uplift.....................	-7.918		-7.59	60.10
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 17.596 kips
Shear force on base = 8.425 kips
Max. available shear force = 12.591 kips

Base pressure at heel = .5134 ksf
Base pressure at toe = 1.9136 ksf

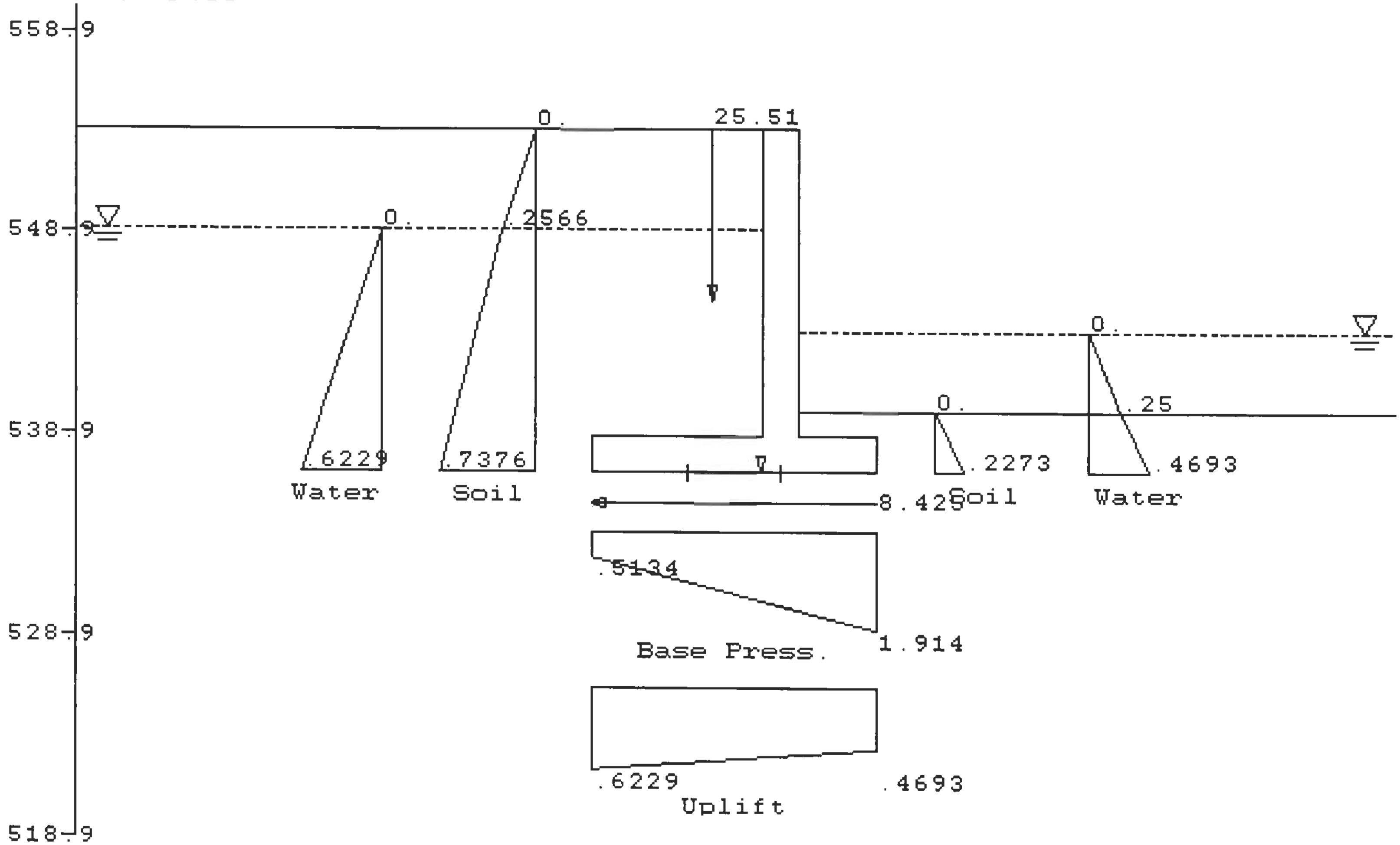
Xr (measured from toe) = 5.86 ft
Resultant ratio = .4039
Stem ratio = .2759
Base in compression = 100.00 %
Overturning ratio = 1.91

Volume of concrete = 1.97 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        -.500        1.000
     3         .000        1.013

  Water pressures on wedges:

             Top       Bottom
    Wedge    press.    press.    x-coord.     press.
    number   (ksf)     (ksf)      (ft)        (ksf)
  ==================================================
      1      .0000     .6229
      2                              .0000      .6229
      2                            14.5000      .4693
      3      .2500     .4693

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =    14.50 ft,   y =   537.00 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   -54.345    20.922     11.916   14.769      4.600
     2      .000    14.500     24.514   14.500      7.918
     3    36.513     5.042       .790    5.042      1.813

  Wedge      Net force
  number      (kips)
  ===================
     1       -10.386
     2         8.812
     3         1.575
  ===================
     SUM =      .000

+------------------------------+
| Factor of safety =    1.515 |
+----------
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I1FS14UL
(14-ft clear height)

Flood / Drawdown condition

1. Short-term soil properties assumed – “Study” case

2. Full-depth water filled crack on driving side

3. Water at El 544 on resisting side

4. Passive soil pressure included on resisting side

5. No surcharge pressure applied

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

Date: **/11/14                                Time: 14.54.15

Flood Wall Stability Analysis Using CTWALL
Filename: I1FS14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   554.00 ft
  Height of stem (HTS)                     =    15.17 ft
  Thickness top of stem (TTS)              =     1.75 ft
  Thickness bottom of stem (TBS)           =     1.75 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.83 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.83 ft
  Width of toe (TWIDTH)                    =     4.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    11.00 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    537.00
      .00    538.83
     5.25    538.83
     5.25    554.00
     7.00    554.00
     7.00    538.83
    11.00    538.83
    11.00    537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	554.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1494.75	554.00
2	5.25	554.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	7.00	540.00
2	507.00	540.00

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 = 549.00 ft
Resisting side elevation = 544.00 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.73

Xr (measured from toe) =   4.17 ft
Resultant ratio        =  .3788
Stem ratio             =  .3636
Base pressure at heel =     .3130 ksf
Base pressure at toe  =    1.9828 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   2.36
```

```
********************** Output Results **********************

Date: **/11/14                                   Time: 14.54.15

Flood Wall Stability Analysis Using CTWALL
Filename: I1FS14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

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

Depth of cracking =    17.00 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       554.00      .0000
       537.00      .7500

** Resisting side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       544.00      .0000
       540.00      .2500
       537.00      .2589
```

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	1.0343

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.7500
11.00	.2589

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	7.002		-5.14	-36.02
Structure, driving side:				
Moist soil.................	2.625		-8.38	-21.98
Saturated soil.............	6.941		-8.37	-58.13
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.............	.608		-2.00	-1.22
Water above structure......	.000		.00	.00
Water above soil...........	1.000		-2.00	-2.00
Driving side:				
Effective earth loads......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		6.375	5.67	36.13
Resisting side:				
Effective earth loads......		-1.551	1.00	-1.55
Water loads................		-1.263	2.62	-3.31
Foundation:				
Vertical force on base.....	-12.627		-4.17	52.61
Shear on base..............		-3.560	.00	.00
Uplift.....................	-5.549		-6.39	35.47
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base          =       .00 degrees
Normal force on base =   12.627 kips
Shear force on base  =    3.560 kips
Max. available shear force =   11.000 kips

Base pressure at heel =    .3130 ksf
Base pressure at toe  =   1.9828 ksf

Xr (measured from toe) =     4.17 ft
Resultant ratio        =    .3788
Stem ratio             =    .3636
Base in compression    =   100.00 %
Overturning ratio      =     1.73

Volume of concrete =     1.73 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	.000
2	8.531	1.000
3	.000	.746

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0000		
2			.0000	.7500
2			11.0000	.2589
3	.2500	.2589		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 537.00 ft
Point 2 (right), x = 11.00 ft, y = 537.00 ft

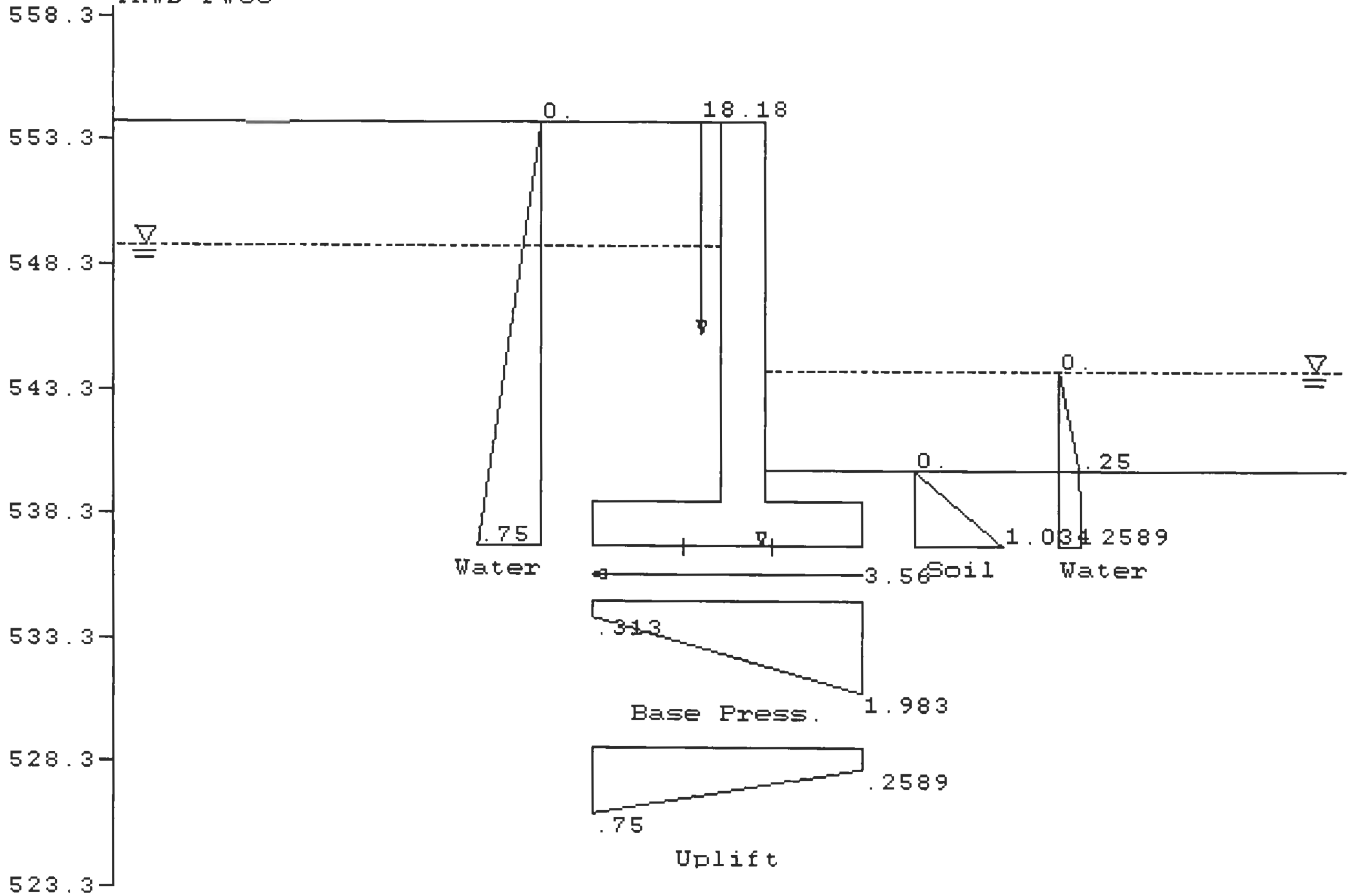
Depth of cracking = 17.00 ft
Crack extends to bottom of base of structure.

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	11.000	17.176	11.000	5.549
3	45.169	4.230	.582	4.230	1.076

Wedge number	Net force (kips)
1	.000
2	-3.875
3	3.875

```
SUM =        .000

+-------------------------------+
| Factor of safety =     2.362 |
+-------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I3EL14UL
(14-ft clear height)

Earthquake condition

1. Long-term soil properties assumed

2. Drained soil above drainage pipe on driving side

3. Passive soil pressure included on resisting side

4. No surcharge pressure

5. Lateral seismic forces accounted for

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

Date: **/11/17                                   Time: 10.08.01

Flood Wall Stability Analysis Using CTWALL
Filename: I3EL14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   554.00 ft
  Height of stem (HTS)                     =    15.17 ft
  Thickness top of stem (TTS)              =     1.75 ft
  Thickness bottom of stem (TBS)           =     1.75 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.83 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.83 ft
  Width of toe (TWIDTH)                    =     1.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =    16.00 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    537.00
       .00    538.83
     13.25    538.83
     13.25    554.00
     15.00    554.00
     15.00    538.83
     16.00    538.83
     16.00    537.00

NCTE: 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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	554.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1486.75	554.00
2	13.25	554.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	15.00	540.00
2	515.00	540.00

Foundation property data:
phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .250 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .250 (ksf)

Water data:
Driving side elevation = 540.50 ft
Resisting side elevation = 537.01 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
Minimum required factors of safety:
  Sliding FS    =    1.10
  Overturning   =     .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.
```

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

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

***************    *** Satisfied ***
* Overturning *    Required base in comp. =    .10 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   4.12

Xr (measured from toe) =   6.48 ft
Resultant ratio        =  .4050
Stem ratio             =  .0625
Base pressure at heel =     .7478 ksf
Base pressure at toe  =    2.7288 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.10
***********    Actual FS     =   2.13
```

```
********************** Output Results **********************

Date: **/11/17                                     Time: 10.08.01

Flood Wall Stability Analysis Using CTWALL
Filename: I3EL14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4205
Calculated earth pressure coefficients:
  Driving side at rest K    =    .5133
  Driving side at rest Kc   =    .7164
  Resisting side at rest K  =   2.6629
  Resisting side at rest Kc =   1.6319
  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)
    ======================
       540.50      .0000
       537.00      .1796

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       554.00      .0000
       540.50      .6929
       537.00      .8343

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
537.01	.0000
537.00	.0007

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	.3989

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.1796
16.00	.0007

** Forces and moments **

Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	8.374		-5.09	-42.60
Structure, driving side:				
Moist soil.................	17.888		-9.38	-167.70
Saturated soil.............	2.877		-9.38	-26.97
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.................	.117		-.50	-.06
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
Driving side:				
Effective earth loads......		7.350	5.71	41.96
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		.314	1.16	.37
Resisting side:				
Effective earth loads......		-.598	.99	-.59
Water loads................		.000	-.10	.00
Foundation:				
Vertical force on base.....	-27.812		-6.48	180.24
Shear on base..............		-7.066	.00	.00
Uplift.....................	-1.443		-10.64	15.36
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 27.812 kips
Shear force on base = 7.066 kips
Max. available shear force = 18.171 kips

Base pressure at heel = .7478 ksf
Base pressure at toe = 2.7288 ksf

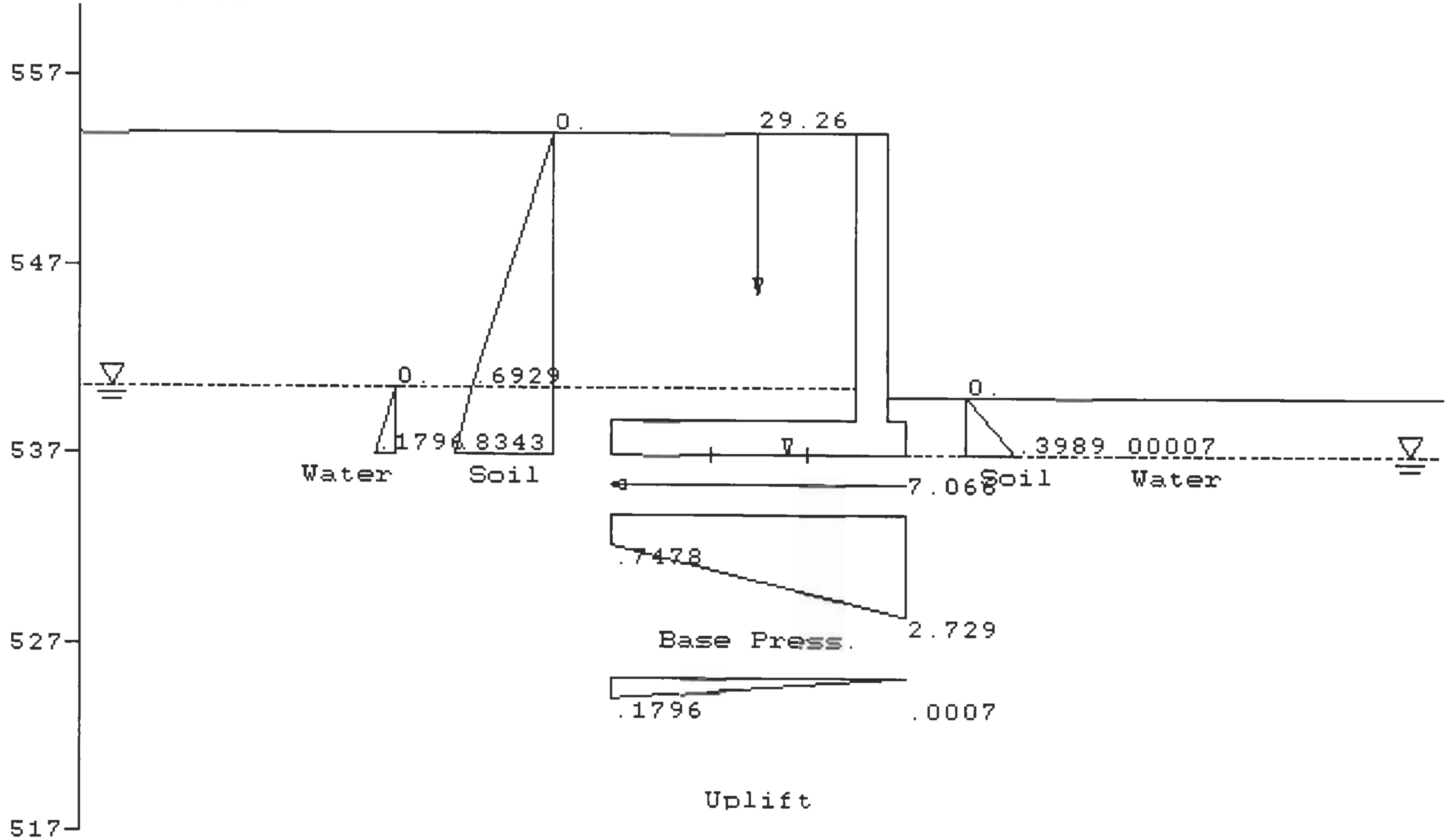
Xr (measured from toe) = 6.48 ft
Resultant ratio = .4050
Stem ratio = .0625
Base in compression = 100.00 %
Overturning ratio = 4.12

Volume of concrete = 2.07 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          .000         .000
     3          .000         .000

  Water pressures on wedges:

               Top      Bottom
    Wedge     press.    press.    x-coord.     press.
    number    (ksf)     (ksf)      (ft)        (ksf)
  ================================================
      1      .0000     .1796
      2                             .0000       .1796
      2                           16.0000       .0007
      3      .0000     .0007

Points of sliding plane:
  Point 1 (left),  x =       .00 ft,    y =   537.00 ft
  Point 2 (right), x =     16.00 ft,    y =   537.00 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     -51.739    21.651     11.541     4.457        .400
     2        .000    16.000     29.255    16.000       1.443
     3      38.535     4.815       .565      .016        .000

  Wedge      Net force
  number      (kips)
  ===================
     1        -9.237
     2         8.514
     3          .722
  ===================
     SUM =      .000

+------------------------------+
| Factor of safety =    2.134 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I4CS14UL

(14-ft clear height)

Construction condition

1. Short-term soil properties assumed

2. Fully drained soil on driving side

3. Passive soil pressure neglected on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14                                   Time: 14.33.59

Flood Wall Stability Analysis Using CTWALL
Filename: I4CS14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)         =   554.00 ft
  Height of stem (HTS)                    =    15.17 ft
  Thickness top of stem (TTS)             =     1.75 ft
  Thickness bottom of stem (TBS)          =     1.75 ft
  Dist. of batter at bot. of stem (TBSR)=        .00 ft
  Depth of heel (THEEL)                   =     1.83 ft
  Distance of batter for heel (BTRH)      =      .00 ft
  Depth of toe (TTOE)                     =     1.83 ft
  Width of toe (TWIDTH)                   =     4.00 ft
  Distance of batter for toe (BTRT)       =      .00 ft
  Width of base (BWIDTH)                  =    12.50 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    537.00
       .00    538.83
      6.75    538.83
      6.75    554.00
      8.50    554.00
      8.50    538.83
     12.50    538.83
     12.50    537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	554.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1493.25	554.00
2	6.75	554.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	537.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	12.50	537.00
2	512.50	537.00

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 = 554.00 ft
- Resisting side elevation = 537.01 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 *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 ***
* Overturning *    Required base in comp. =  75.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.83

Xr (measured from toe) =   4.46 ft
Resultant ratio        =  .3569
Stem ratio             =  .3200
Base pressure at heel =     .1930 ksf
Base pressure at toe  =    2.5401 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.33
***********    Actual FS     =   1.38
```

********************* Output Results *********************

Date: **/11/14 Time: 14.33.59

Flood Wall Stability Analysis Using CTWALL
Filename: I4CS14UL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

```
***************************
**  Overturning Results  **
***************************
```

Solution converged in 1 iterations.

```
SMF used to calculate K's =    .6667
Alpha for the SMF          = -45.0845
Calculated earth pressure coefficients:
  Driving side at rest K     =   1.0000
  Driving side at rest Kc    =   1.0000
  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 = 10.26 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
554.00	.0000
543.74	.6410
537.00	.6904

Earth pressures:

Elevation (ft)	Pressure (ksf)
554.00	.0000
543.74	.0000
537.00	.7522

Surcharge pressures:

Elev. (ft)	Press. (ksf)
543.74	.100
537.00	.100

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
537.01	.0000
537.00	.0006
537.00	.0006

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.6904
12.50	.0006

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	7.413		-5.51	-40.86
Structure, driving side:				
Moist soil................	.000		.00	.00
Saturated soil............	13.312		-9.13	-121.47
Water above structure......	.000		.00	.00
Water above soil..........	.000		.00	.00
External vertical loads....	.675		-9.13	-6.16
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......		2.536	2.25	5.70
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.674	3.37	2.27
Water loads................		7.777	6.22	48.34
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	1.01	.00
Foundation:				
Vertical force on base.....	-17.081		-4.46	76.20
Shear on base..............		-10.987	.00	.00
Uplift.....................	-4.319		-8.33	35.97
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 17.081 kips
Shear force on base = 10.987 kips
Max. available shear force = 12.500 kips

Base pressure at heel = .1930 ksf
Base pressure at toe = 2.5401 ksf

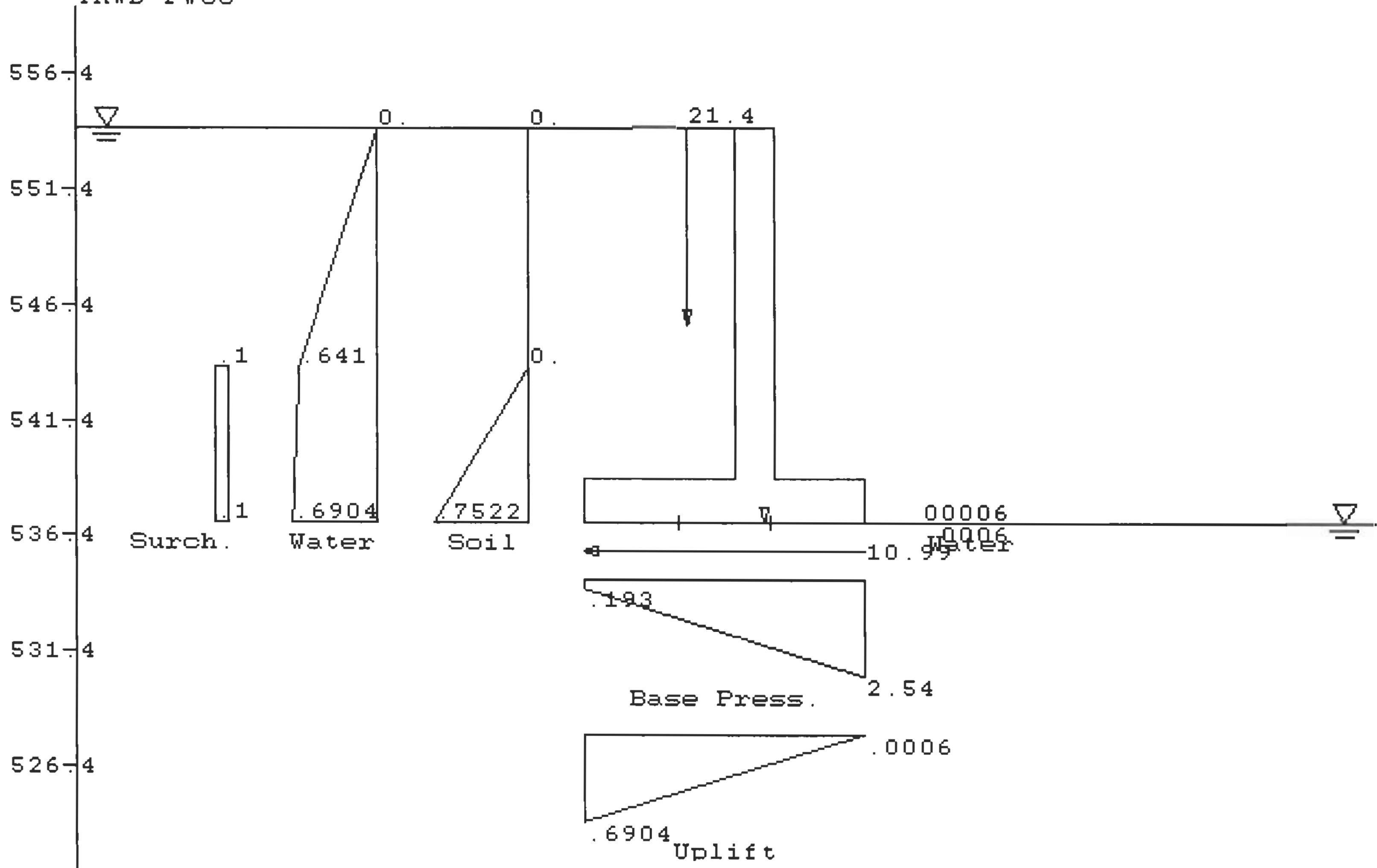
Xr (measured from toe) = 4.46 ft
Resultant ratio = .3569
Stem ratio = .3200
Base in compression = 100.00 %
Overturning ratio = 1.83

Volume of concrete = 1.83 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         9.031         .675
     3          .000         .000

  Water pressures on wedges:

              Top       Bottom
    Wedge    press.    press.    x-coord.     press.
    number   (ksf)     (ksf)      (ft)        (ksf)
  ================================================
      1      .0000     .0000
      2                              .0000     1.0625
      2                            12.5000      .0006
      3      .0000     .0000

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =    12.50 ft,   y =   537.00 ft

Depth of cracking =    17.00 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    12.500     20.725    12.500      6.645
     3      .000      .000       .000      .000       .000

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

+------------------------------+
| Factor of safety =    1.384 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I4CL14UL
(14-ft clear height)

Construction condition

1. Long-term soil properties assumed

2. Fully drained soil on driving side

3. Passive soil pressure neglected on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14 Time: 14.52.08

Flood Wall Stability Analysis Using CTWALL
Filename: I4CL14UL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

Structural geometry data:

Elevation of top of stem (ELTS)	=	554.00	ft
Height of stem (HTS)	=	15.17	ft
Thickness top of stem (TTS)	=	1.75	ft
Thickness bottom of stem (TBS)	=	1.75	ft
Dist. of batter at bot. of stem (TBSR)	=	.00	ft
Depth of heel (THEEL)	=	1.83	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	1.83	ft
Width of toe (TWIDTH)	=	4.00	ft
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	11.00	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	537.00
.00	538.83
5.25	538.83
5.25	554.00
7.00	554.00
7.00	538.83
11.00	538.83
11.00	537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	554.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1494.75	554.00
2	5.25	554.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	537.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	11.00	537.00
2	511.00	537.00

Foundation property data:
phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .250 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .250 (ksf)

Water data:
Driving side elevation = 537.01 ft
Resisting side elevation = 537.01 ft
Unit weight of water = .0625 kcf
Seepage pressures computed are hydrostatic.

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

***************    *** Satisfied ***
* Overturning *    Required base in comp. =  75.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.16

Xr (measured from toe) =   3.72 ft
Resultant ratio        =  .3384
Stem ratio             =  .3636
Base pressure at heel =     .0427 ksf
Base pressure at toe  =    2.7725 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.33
***********    Actual FS     =   1.37
```

```
********************** Output Results **********************

Date: **/11/14                                        Time: 14.52.08

Flood Wall Stability Analysis Using CTWALL
Filename: I4CL14UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4205
Calculated earth pressure coefficients:
  Driving side at rest K     =     .5133
  Driving side at rest Kc    =     .7164
  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)
    ======================
       537.01      .0000
       537.00      .0006

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       554.00      .0000
       537.01      .8721
       537.00      .8724
```

Surcharge pressures:

Elev. (ft)	Press. (ksf)
554.00	.051
537.00	.051

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
537.01	.0000
537.00	.0006
537.00	.0006

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.0006
11.00	.0006

** Forces and moments **

Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	7.002		-5.14	-36.02
Structure, driving side:				
Moist soil................	7.964		-8.37	-66.70
Saturated soil............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil..........	.000		.00	.00
External vertical loads....	.525		-8.38	-4.40
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......		7.417	5.67	42.03
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.873	8.50	7.42
Water loads...............		.000	-.62	.00
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads...............		.000	-.62	.00
Foundation:				
Vertical force on base.....	-15.484		-3.72	57.64
Shear on base.............		-8.289	.00	.00
Uplift....................	-.007		-5.50	.04
** Statics Check ** SUMS =	.000	.000		.00

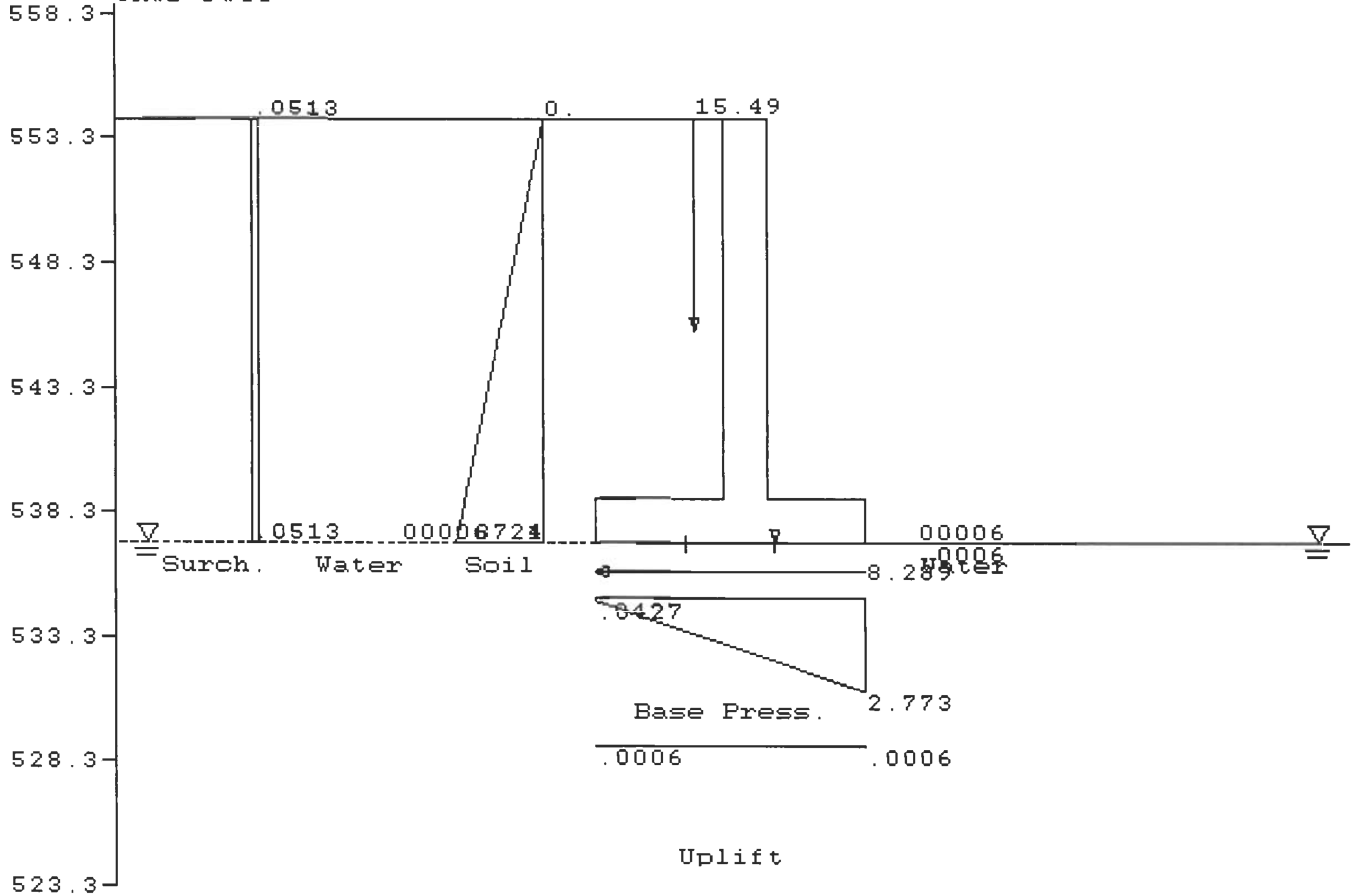
```
Angle of base        =      .00 degrees
Normal force on base =   15.484 kips
Shear force on base  =    8.289 kips
Max. available shear force =   10.639 kips

Base pressure at heel =    .0427 ksf
Base pressure at toe  =   2.7725 ksf

Xr (measured from toe) =     3.72 ft
Resultant ratio        =    .3384
Stem ratio             =    .3636
Base in compression    =   100.00 %
Overturning ratio      =     2.16

Volume of concrete =     1.73 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       1.177
     2         .000        .525
     3         .000        .000

  Water pressures on wedges:

              Top      Bottom
    Wedge    press.   press.   x-coord.    press.
    number   (ksf)    (ksf)     (ft)       (ksf)
  ================================================
      1     .0000     .0006
      2                           .0000      .0006
      2                         11.0000      .0006
      3     .0000     .0000

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =    11.00 ft,   y =   537.00 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   -55.311   20.675    10.002      .012       .000
     2      .000   11.000    14.966    11.000       .007
     3      .000     .000      .000      .000       .000

  Wedge     Net force
  number     (kips)
  ===================
     1       -7.787
     2        7.786
     3         .000
  ===================
     SUM =     .000

+-----------------------------
```

```
+
      | Factor of safety =    1.366 |
      +-----------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I1NL6UL
(6-ft clear height)

Normal condition

1. Long-term soil properties assumed

2. Drained soil above drainage pipe on driving side

3. Passive soil pressure included on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14   Time: 14.56.36

Flood Wall Stability Analysis Using CTWALL
Filename: I1NL6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:

Elevation of top of stem (ELTS)	=	546.00	ft
Height of stem (HTS)	=	7.50	ft
Thickness top of stem (TTS)	=	1.17	ft
Thickness bottom of stem (TBS)	=	1.17	ft
Dist. of batter at bot. of stem (TBSR)	=	.00	ft
Depth of heel (THEEL)	=	1.50	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	1.50	ft
Width of toe (TWIDTH)	=	2.00	ft
Distance of batter for toe (BTRT)	=	.00	ft
Width of base (BWIDTH)	=	6.50	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	537.00
.00	538.50
3.33	538.50
3.33	546.00
4.50	546.00
4.50	538.50
6.50	538.50
6.50	537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	546.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1496.67	546.00
2	3.33	546.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	4.50	540.00
2	504.50	540.00

Foundation property data:
  phi for soil-structure interface = 27.00 (deg)
  c for soil-structure interface = .250 (ksf)
  phi for soil-soil interface = 27.00 (deg)
  c for soil-soil interface = .250 (ksf)

Water data:
  Driving side elevation = 540.50 ft
  Resisting side elevation = 537.01 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    =    1.50
  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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.24

Xr (measured from toe) =   2.33 ft
Resultant ratio        =  .3580
Stem ratio             =  .3077
Base pressure at heel =     .1285 ksf
Base pressure at toe  =    1.6079 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   1.90
```

```
********************** Output Results **********************

Date: **/11/14                                    Time: 14.56.36

Flood Wall Stability Analysis Using CTWALL
Filename: I1NL6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4214
Calculated earth pressure coefficients:
  Driving side at rest K     =    .5133
  Driving side at rest Kc    =    .7164
  Resisting side at rest K   =   2.6629
  Resisting side at rest Kc =   1.6319
  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)
    ======================
       540.50      .0000
       537.00      .1425

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       546.00      .0000
       540.50      .2823
       537.00      .4427
```

Surcharge pressures:

Elev. (ft)	Press. (ksf)
546.00	.051
537.00	.051

** Resisting side pressures **

Water pressures:

Elevation (ft)	Pressure (ksf)
537.01	.0000
537.00	.0008

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	.3987

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.1425
6.50	.0008

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	2.779		-2.94	-8.16
Structure, driving side:				
Moist soil.................	1.831		-4.84	-8.86
Saturated soil.............	.866		-4.84	-4.19
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.333		-4.84	-1.61
Ext. horz. pressure loads..		.000	.00	.00
Ext. horz. line loads......		.000	.00	.00
Structure, resisting side:				
Moist soil.................	.300		-1.00	-.30
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
Driving side:				
Effective earth loads......		2.045	3.03	6.20
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.462	4.50	2.08
Water loads................		.249	1.16	.29
Resisting side:				
Effective earth loads......		-.598	1.01	-.60
Water loads................		.000	2.15	.00
Foundation:				
Vertical force on base.....	-5.643		-2.33	13.13
Shear on base..............		-2.158	.00	.00
Uplift.....................	-.466		-4.32	2.01
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 5.643 kips
Shear force on base = 2.158 kips
Max. available shear force = 4.500 kips

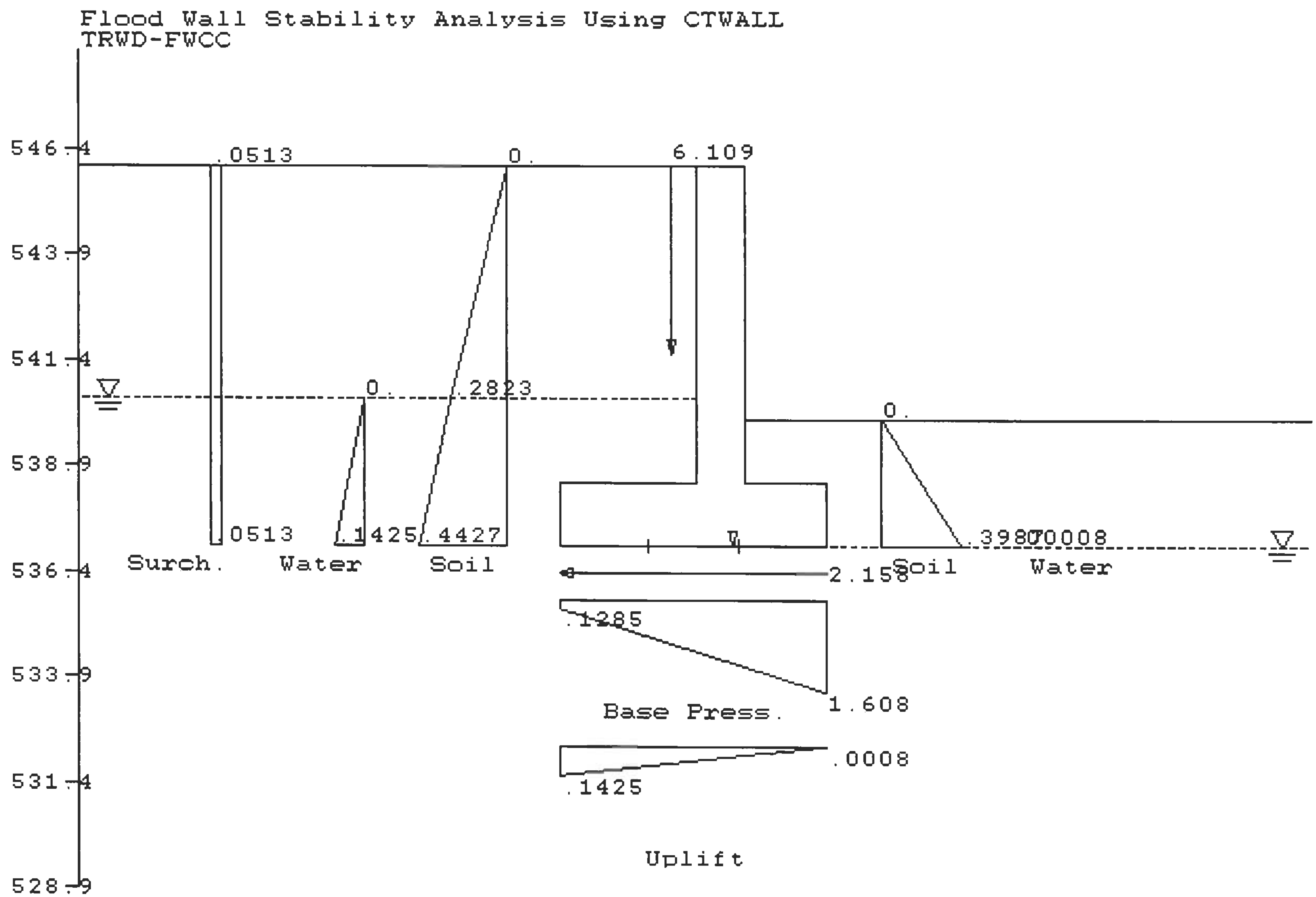
Base pressure at heel = .1285 ksf
Base pressure at toe = 1.6079 ksf

Xr (measured from toe) = 2.33 ft
Resultant ratio = .3580
Stem ratio = .3077
Base in compression = 100.00 %
Overturning ratio = 2.24

Volume of concrete = .69 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        .688
     2        .000        .333
     3        .000        .000

  Water pressures on wedges:

             Top       Bottom
    Wedge    press.    press.   x-coord.    press.
    number   (ksf)     (ksf)     (ft)       (ksf)
  ================================================
      1     .0000     .1425
      2                           .0000      .1425
      2                          6.5000      .0008
      3     .0000     .0008

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =     6.50 ft,   y =   537.00 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   -52.608    11.328     3.236     4.405       .314
     2      .000     6.500     5.776     6.500       .466
     3    37.717     4.904      .582      .016       .000

  Wedge     Net force
  number     (kips)
  ===================
     1       -3.127
     2        2.364
     3         .764
  ===================
     SUM =     .000

+------------------------------+
| Factor of safety =    1.904 |
+------------------------------+
```


Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC
546.4
543.9
541.4
538.9
536.4
533.9
531.4
528.9
.0513
.0513
Surch.
0.
.1425
Water
0.
.2823
.4427
Soil
6.109
2.158
.1285
1.608
Base Press.
.0008
.1425
Uplift
0.
.3980
.0008
Soil
Water

Upper Level Retaining Walls: I1FL6UL
(6-ft clear height)

Flood / Drawdown condition

1. Long-term soil properties assumed

2. Hydrostatic pressure to El 543.5 on driving side

3. Water at El 541 on resisting side

4. Passive soil pressure included on resisting side

5. No surcharge pressure applied

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

Date: **/11/14                                   Time: 14.58.57

Flood Wall Stability Analysis Using CTWALL
Filename: I1FL6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   546.00 ft
  Height of stem (HTS)                     =     7.50 ft
  Thickness top of stem (TTS)              =     1.17 ft
  Thickness bottom of stem (TBS)           =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=          .00 ft
  Depth of heel (THEEL)                    =     1.50 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.50 ft
  Width of toe (TWIDTH)                    =     2.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =     6.50 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    537.00
       .00    538.50
      3.33    538.50
      3.33    546.00
      4.50    546.00
      4.50    538.50
      6.50    538.50
      6.50    537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	546.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1496.67	546.00
2	3.33	546.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	4.50	540.00
2	504.50	540.00

Foundation property data:
phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .250 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .250 (ksf)

Water data:
Driving side elevation = 543.50 ft
Resisting side elevation = 541.00 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.62

Xr (measured from toe) =   2.18 ft
Resultant ratio        =  .3352
Stem ratio             =  .3077
Base pressure at heel =     .0074 ksf
Base pressure at toe  =    1.3062 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   1.78
```

```
********************** Output Results **********************

Date: **/11/14                                    Time: 14.58.57

Flood Wall Stability Analysis Using CTWALL
Filename: I1FL6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4214
Calculated earth pressure coefficients:
  Driving side at rest K     =    .5133
  Driving side at rest Kc    =    .7164
  Resisting side at rest K   =   2.6629
  Resisting side at rest Kc  =   1.6319
  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)
    ======================
       543.50      .0000
       537.00      .3428

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       546.00      .0000
       543.50      .1283
       537.00      .3861

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
541.00	.0000
540.00	.0625
537.00	.2793

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	.2306

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.3428
6.50	.2793

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	2.779		-2.94	-8.16
Structure, driving side:				
Moist soil.................	.832		-4.84	-4.03
Saturated soil.............	2.165		-4.84	-10.47
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.............	.390		-1.00	-.39
Water above structure......	.000		.00	.00
Water above soil...........	.125		-1.00	-.13
Driving side:				
Effective earth loads......		1.832	3.12	5.71
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		1.114	2.17	2.41
Resisting side:				
Effective earth loads......		-.346	1.00	-.35
Water loads................		-.544	1.31	-.71
Foundation:				
Vertical force on base.....	-4.269		-2.18	9.30
Shear on base..............		-2.056	.00	.00
Uplift.....................	-2.022		-3.36	6.79
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 4.269 kips
Shear force on base = 2.056 kips
Max. available shear force = 3.800 kips

Base pressure at heel = .0074 ksf
Base pressure at toe = 1.3062 ksf

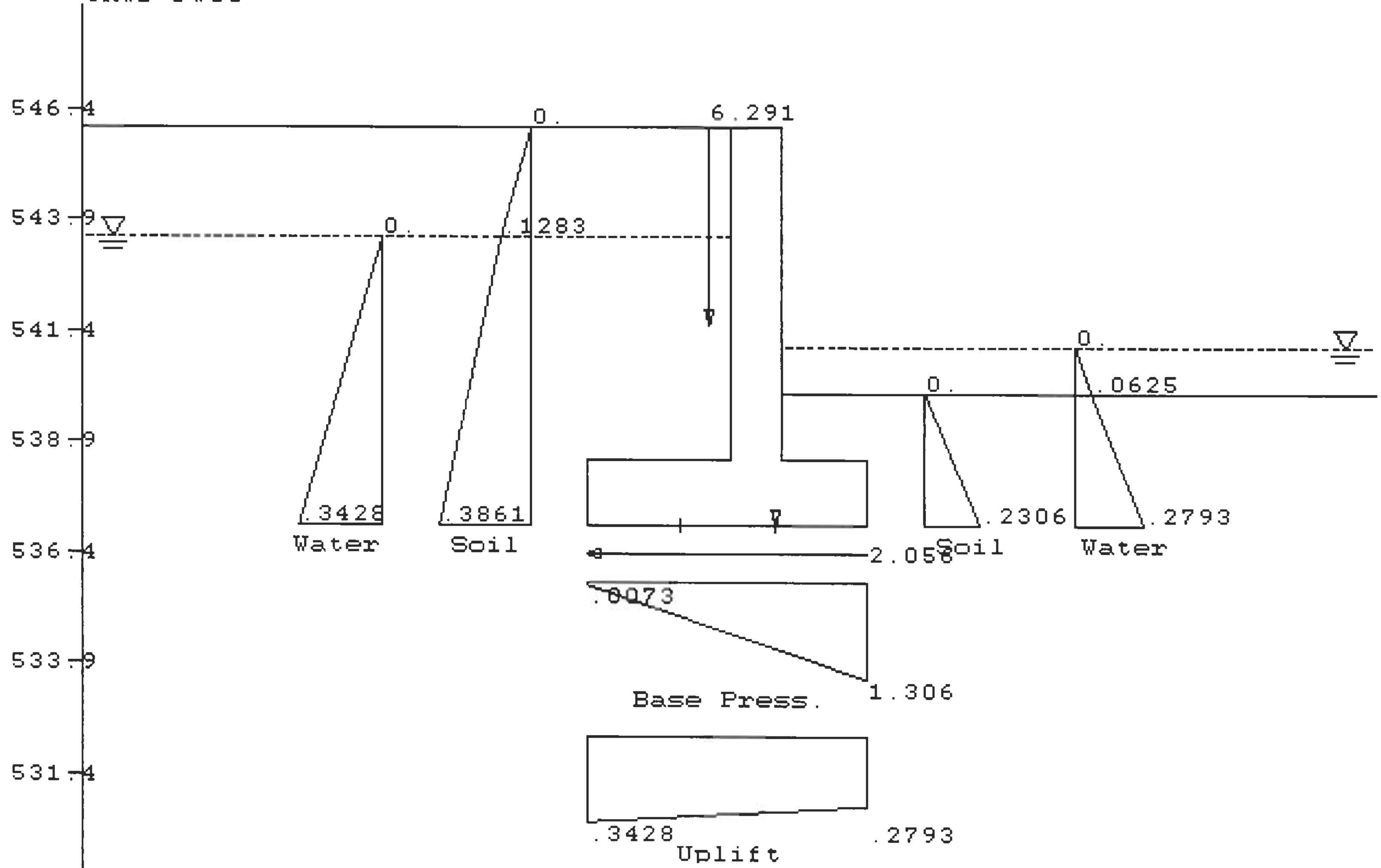
Xr (measured from toe) = 2.18 ft
Resultant ratio = .3352
Stem ratio = .3077
Base in compression = 100.00 %
Overturning ratio = 1.62

Volume of concrete = .69 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        -.031         .125
     3         .000         .245

  Water pressures on wedges:

              Top      Bottom
    Wedge    press.   press.   x-coord.    press.
    number   (ksf)    (ksf)     (ft)       (ksf)
  ==============================================
      1     .0000     .3428
      2                           .0000      .3428
      2                          6.5000      .2793
      3     .0625     .2793

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =     6.50 ft,   y =   537.00 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   -53.091    11.256      3.518    8.129      1.393
     2      .000     6.500      6.166    6.500      2.022
     3    37.404     4.939       .765    4.939       .844

  Wedge      Net force
  number      (kips)
  ===================
     1        -3.141
     2         2.170
     3          .970
  ===================
     SUM =      .000

+-----------------------------+
| Factor of safety =    1.776 |
+----------
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I1FS6UL
(6-ft clear height)

Flood / Drawdown condition

1. Short-term soil properties assumed – “Study” case

2. Full-depth water filled crack on driving side

3. Water at El 541 on resisting side

4. Passive soil pressure included on resisting side

5. No surcharge pressure applied

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

Date: **/11/14                                   Time: 15.06.36

Flood Wall Stability Analysis Using CTWALL
Filename: I1FS6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)         =   546.00 ft
  Height of stem (HTS)                    =     7.50 ft
  Thickness top of stem (TTS)             =     1.17 ft
  Thickness bottom of stem (TBS)          =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=        .00 ft
  Depth of heel (THEEL)                   =     1.50 ft
  Distance of batter for heel (BTRH)      =      .00 ft
  Depth of toe (TTOE)                     =     1.50 ft
  Width of toe (TWIDTH)                   =     2.00 ft
  Distance of batter for toe (BTRT)       =      .00 ft
  Width of base (BWIDTH)                  =     4.50 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    537.00
      .00    538.50
     1.33    538.50
     1.33    546.00
     2.50    546.00
     2.50    538.50
     4.50    538.50
     4.50    537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	546.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1498.67	546.00
2	1.33	546.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	2.50	540.00
2	502.50	540.00

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 = 543.50 ft
Resisting side elevation = 541.00 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
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 ***
* Overturning *    Required base in comp. = 100.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.45

Xr (measured from toe) =   1.52 ft
Resultant ratio        =  .3378
Stem ratio             =  .4444
Base pressure at heel =     .0159 ksf
Base pressure at toe  =    1.1550 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.50
***********    Actual FS     =   6.08
```

```
********************** Output Results **********************

Date: **/11/14                                   Time: 15.06.36

Flood Wall Stability Analysis Using CTWALL
Filename: I1FS6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

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

Depth of cracking =      9.00 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       546.00      .0000
       537.00      .4063

** Resisting side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       541.00      .0000
       540.00      .0625
       537.00      .2188
```

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	1.0387

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.4063
4.50	.2188

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	2.329		-2.44	-5.68
Structure, driving side:				
Moist soil.................	.332		-3.83	-1.28
Saturated soil.............	.865		-3.84	-3.32
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.............	.390		-1.00	-.39
Water above structure......	.000		.00	.00
Water above soil...........	.125		-1.00	-.13
Driving side:				
Effective earth loads......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		1.828	3.00	5.48
Resisting side:				
Effective earth loads......		-1.558	1.00	-1.56
Water loads................		-.453	1.37	-.62
Foundation:				
Vertical force on base.....	-2.634		-1.52	4.01
Shear on base..............		.183	.00	.00
Uplift.....................	-1.406		-2.47	3.48
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base         =      .00 degrees
Normal force on base =    2.634 kips
Shear force on base  =    -.183 kips
Max. available shear force =    4.500 kips

Base pressure at heel =    .0159 ksf
Base pressure at toe  =   1.1550 ksf

Xr (measured from toe) =     1.52 ft
Resultant ratio         =    .3378
Stem ratio              =    .4444
Base in compression     =   100.00 %
Overturning ratio       =     1.45

Volume of concrete =      .57 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	.000
2	2.500	.125
3	.000	.186

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0000		
2			.0000	.4063
2			4.5000	.2188
3	.0625	.2188		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 537.00 ft
Point 2 (right), x = 4.50 ft, y = 537.00 ft

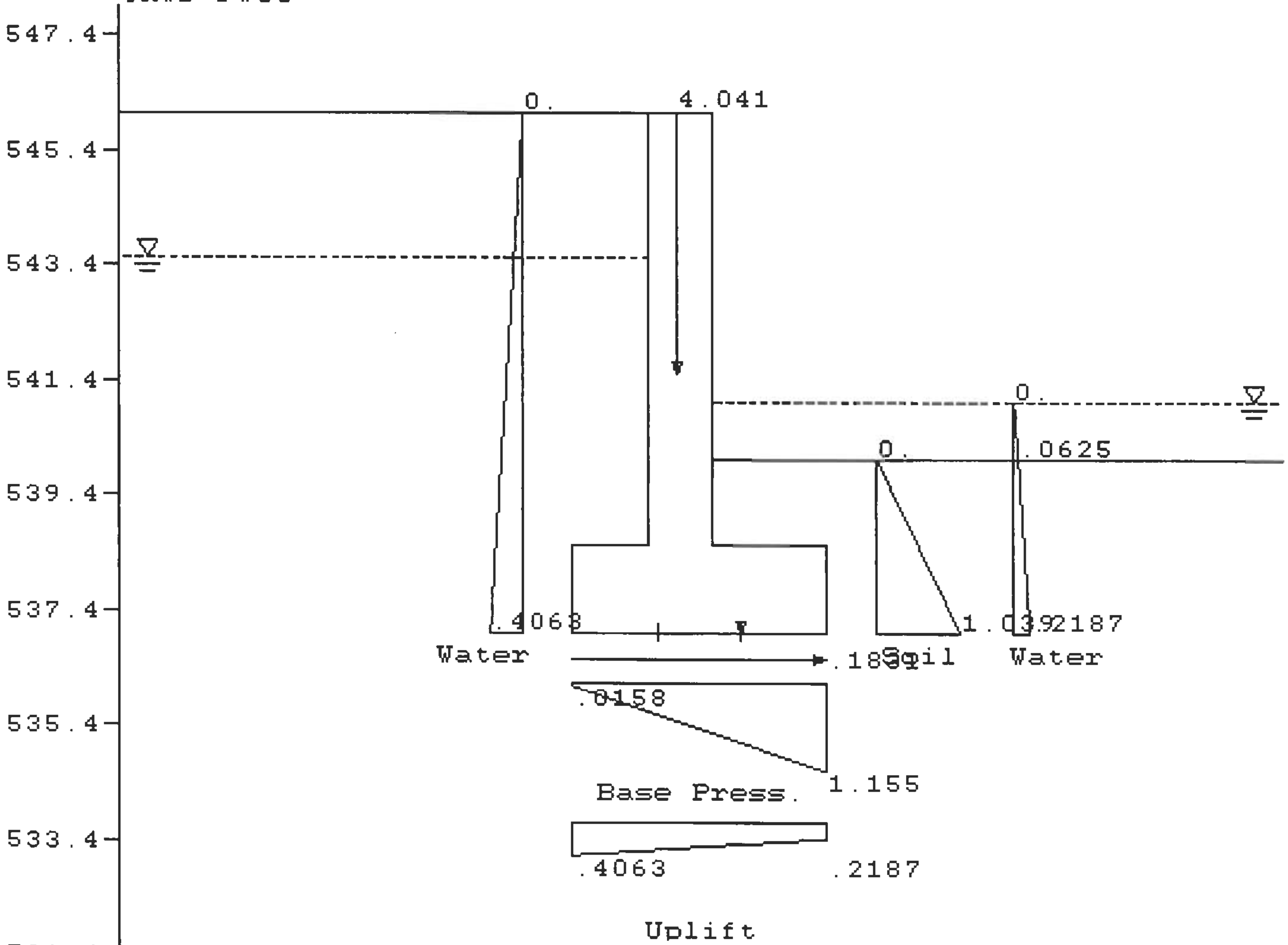
Depth of cracking = 9.00 ft
Crack extends to bottom of base of structure.

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	4.500	3.916	4.500	1.406
3	45.159	4.231	.582	4.231	.595

Wedge number	Net force (kips)
1	.000
2	-1.759
3	1.760

```
SUM =      .000

+------------------------------+
| Factor of safety =    6.077 |
+------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I3EL6UL
(6-ft clear height)

Earthquake condition

1. Long-term soil properties assumed

2. Drained soil above drainage pipe on driving side

3. Passive soil pressure included on resisting side

4. No surcharge pressure

5. Lateral seismic forces included

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

Date: **/11/17 Time: 9.40.21

Flood Wall Stability Analysis Using CTWALL
Filename: I3EL6UL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

Structural geometry data:

Elevation of top of stem (ELTS)	=	546.00 ft
Height of stem (HTS)	=	7.50 ft
Thickness top of stem (TTS)	=	1.17 ft
Thickness bottom of stem (TBS)	=	1.17 ft
Dist. of batter at bot. of stem (TBSR)	=	.00 ft
Depth of heel (THEEL)	=	1.50 ft
Distance of batter for heel (BTRH)	=	.00 ft
Depth of toe (TTOE)	=	1.50 ft
Width of toe (TWIDTH)	=	1.00 ft
Distance of batter for toe (BTRT)	=	.00 ft
Width of base (BWIDTH)	=	6.50 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	537.00
.00	538.50
4.33	538.50
4.33	546.00
5.50	546.00
5.50	538.50
6.50	538.50
6.50	537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	546.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1495.67	546.00
2	4.33	546.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	540.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	5.50	540.00
2	505.50	540.00

Foundation property data:

phi for soil-structure interface = 27.00 (deg)
c for soil-structure interface = .250 (ksf)
phi for soil-soil interface = 27.00 (deg)
c for soil-soil interface = .250 (ksf)

Water data:

Driving side elevation = 540.50 ft
Resisting side elevation = 537.01 ft
Unit weight of water = .0625 kcf
Seepage pressures computed by Line of Creep method.

```
Minimum required factors of safety:
  Sliding FS    =    1.10
  Overturning   =     .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.
```

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

Flood Wall Stability Analysis Using CTWALL

Project name: TRWD-FWCC

***************    *** Satisfied ***
* Overturning *    Required base in comp. =    .10 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   2.67

Xr (measured from toe) =   2.38 ft
Resultant ratio        =  .3665
Stem ratio             =  .1538
Base pressure at heel =     .1827 ksf
Base pressure at toe  =    1.6543 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.10
***********    Actual FS     =   2.24
```

```
********************** Output Results **********************

Date: **/11/17                                     Time:  9.40.21

Flood Wall Stability Analysis Using CTWALL
Filename: I3EL6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =     .6667
Alpha for the SMF          = -54.4214
Calculated earth pressure coefficients:
  Driving side at rest K     =    .5133
  Driving side at rest Kc    =    .7164
  Resisting side at rest K   =   2.6629
  Resisting side at rest Kc =   1.6319
  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)
    ======================
       540.50      .0000
       537.00      .1425

  Earth pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       546.00      .0000
       540.50      .2823
       537.00      .4427

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
537.01	.0000
537.00	.0008

Earth pressures:

Elevation (ft)	Pressure (ksf)
540.00	.0000
537.00	.3987

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.1425
6.50	.0008

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	2.779		-2.46	-6.84
Structure, driving side:				
Moist soil................	2.382		-4.34	-10.32
Saturated soil............	1.126		-4.33	-4.88
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................	.150		-.50	-.08
Saturated soil............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil..........	.000		.00	.00
Driving side:				
Effective earth loads......		2.045	3.03	6.20
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads...............		.249	1.16	.29
Resisting side:				
Effective earth loads......		-.598	1.01	-.60
Water loads...............		.000	2.15	.00
Foundation:				
Vertical force on base.....	-5.970		-2.38	14.22
Shear on base.............		-1.696	.00	.00
Uplift....................	-.466		-4.32	2.01
** Statics Check ** SUMS =	.000	.000		.00

```
Angle of base        =      .00 degrees
Normal force on base =    5.970 kips
Shear force on base  =    1.696 kips
Max. available shear force =    4.667 kips

Base pressure at heel =    .1827 ksf
Base pressure at toe  =   1.6543 ksf

Xr (measured from toe) =     2.38 ft
Resultant ratio        =    .3665
Stem ratio             =    .1538
Base in compression    =   100.00 %
Overturning ratio      =     2.67

Volume of concrete =      .69 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	.000
2	.000	.000
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.1425		
2			.0000	.1425
2			6.5000	.0008
3	.0000	.0008		

Points of sliding plane:
  Point 1 (left), x =   .00 ft,   y =   537.00 ft
  Point 2 (right), x =   6.50 ft,   y =   537.00 ft

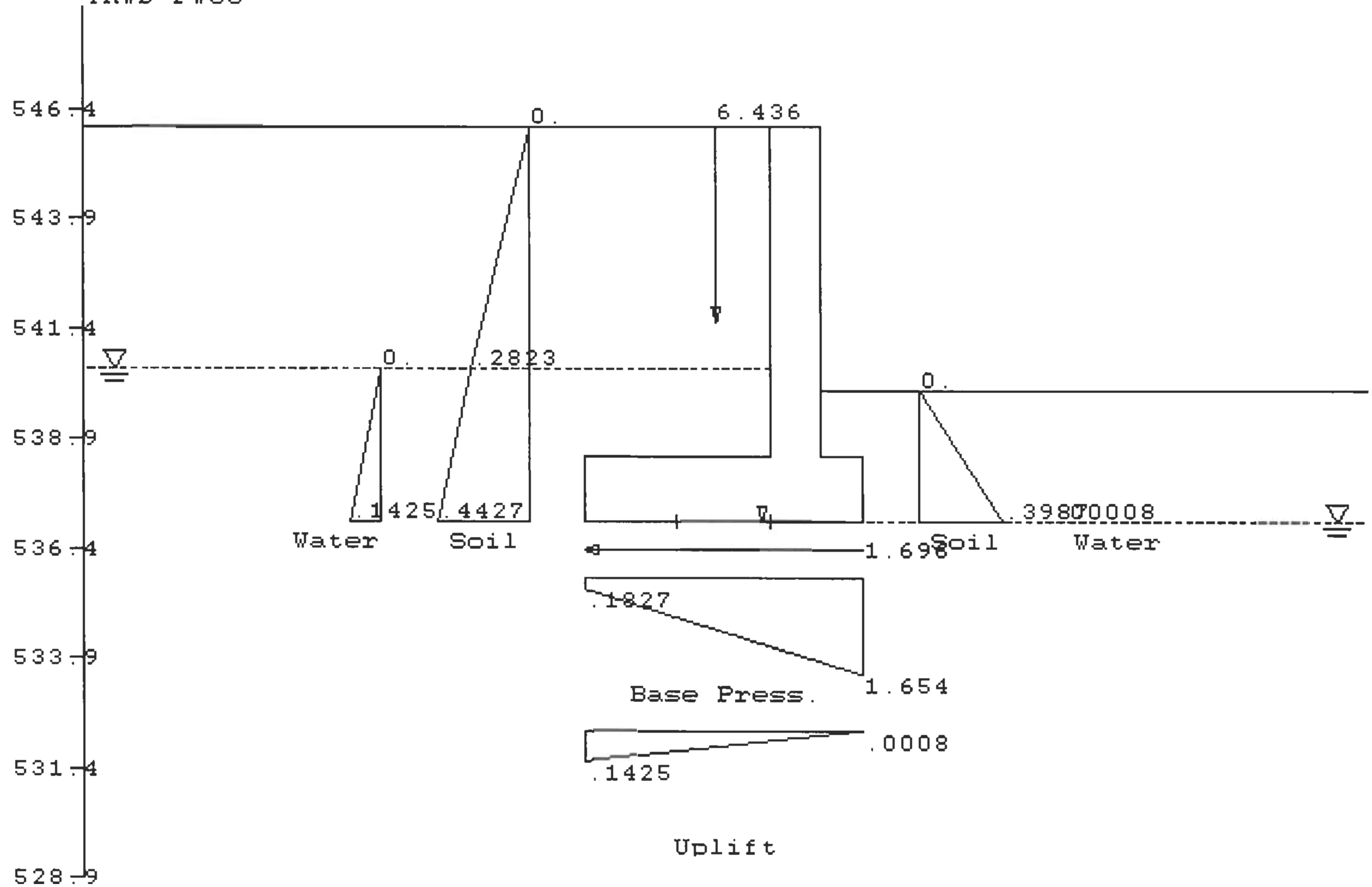
Depth of cracking =   .00 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	-51.452	11.508	3.374	4.475	.319
2	.000	6.500	6.436	6.500	.466
3	38.686	4.800	.562	.016	.000

Wedge number	Net force (kips)
1	-2.788
2	2.082
3	.706
SUM =	.000

```
+-----------------------------+
| Factor of safety =    2.242 |
+-----------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I4CS6UL

(6-ft clear height)

Construction condition

1. Short-term soil properties assumed

2. Fully drained soil on driving side

3. Passive soil pressure neglected on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14                                    Time: 15.02.32

Flood Wall Stability Analysis Using CTWALL
Filename: I4CS6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

Structural geometry data:
  Elevation of top of stem (ELTS)          =   546.00 ft
  Height of stem (HTS)                     =     7.50 ft
  Thickness top of stem (TTS)              =     1.17 ft
  Thickness bottom of stem (TBS)           =     1.17 ft
  Dist. of batter at bot. of stem (TBSR)=         .00 ft
  Depth of heel (THEEL)                    =     1.50 ft
  Distance of batter for heel (BTRH)       =      .00 ft
  Depth of toe (TTOE)                      =     1.50 ft
  Width of toe (TWIDTH)                    =     2.00 ft
  Distance of batter for toe (BTRT)        =      .00 ft
  Width of base (BWIDTH)                   =     6.50 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    537.00
      .00    538.50
     3.33    538.50
     3.33    546.00
     4.50    546.00
     4.50    538.50
     6.50    538.50
     6.50    537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
.00	1.000	.100	.130	.00	546.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1496.67	546.00
2	3.33	546.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
.00	1.000	.100	.130	537.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	6.50	537.00
2	506.50	537.00

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 = 546.00 ft
Resisting side elevation = 537.01 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 *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 ***
* Overturning *    Required base in comp. =  75.00 %
***************    Actual base in comp.   = 100.00 %
                   Overturning ratio      =   1.64

Xr (measured from toe) =   2.20 ft
Resultant ratio        =  .3378
Stem ratio             =  .3077
Base pressure at heel =     .0188 ksf
Base pressure at toe  =    1.3745 ksf

***********    *** Satisfied ***
* Sliding *    Min. Required =   1.33
***********    Actual FS     =   2.57
```

```
********************** Output Results **********************

Date: **/11/14                                    Time: 15.02.32

Flood Wall Stability Analysis Using CTWALL
Filename: I4CS6UL.DAT

Company name:
  CDM
Project name:
  TRWD-FWCC
Project location:
  Fort Worth, TX / Tarrant Regional Water District
Wall location:
  Walls at bypass channel
Computed by: BDA

***************************
**  Overturning Results  **
***************************

Solution converged in  1 iterations.

SMF used to calculate K's =    .6667
Alpha for the SMF          =    .0000
Calculated earth pressure coefficients:
  Driving side at rest K     =    .0000
  Driving side at rest Kc    =    .0000
  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 =     9.00 ft
Crack extends to bottom of base of structure.

** Driving side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    ======================
       546.00      .0000
       537.00      .5625

  Surcharge pressures:
       Elev.   Press.
       (ft)    (ksf)
    ===================

** Resisting side pressures **
```

Water pressures:

Elevation (ft)	Pressure (ksf)
537.01	.0000
537.00	.0006
537.00	.0006

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.5625
6.50	.0006

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	2.779		-2.94	-8.16
Structure, driving side:				
Moist soil.................	.000		.00	.00
Saturated soil.............	3.247		-4.84	-15.70
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.333		-4.84	-1.61
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......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		2.531	3.00	7.59
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	1.68	.00
Foundation:				
Vertical force on base.....	-4.528		-2.20	9.94
Shear on base..............		-2.531	.00	.00
Uplift.....................	-1.830		-4.33	7.93
** Statics Check ** SUMS =	.000	.000		.00

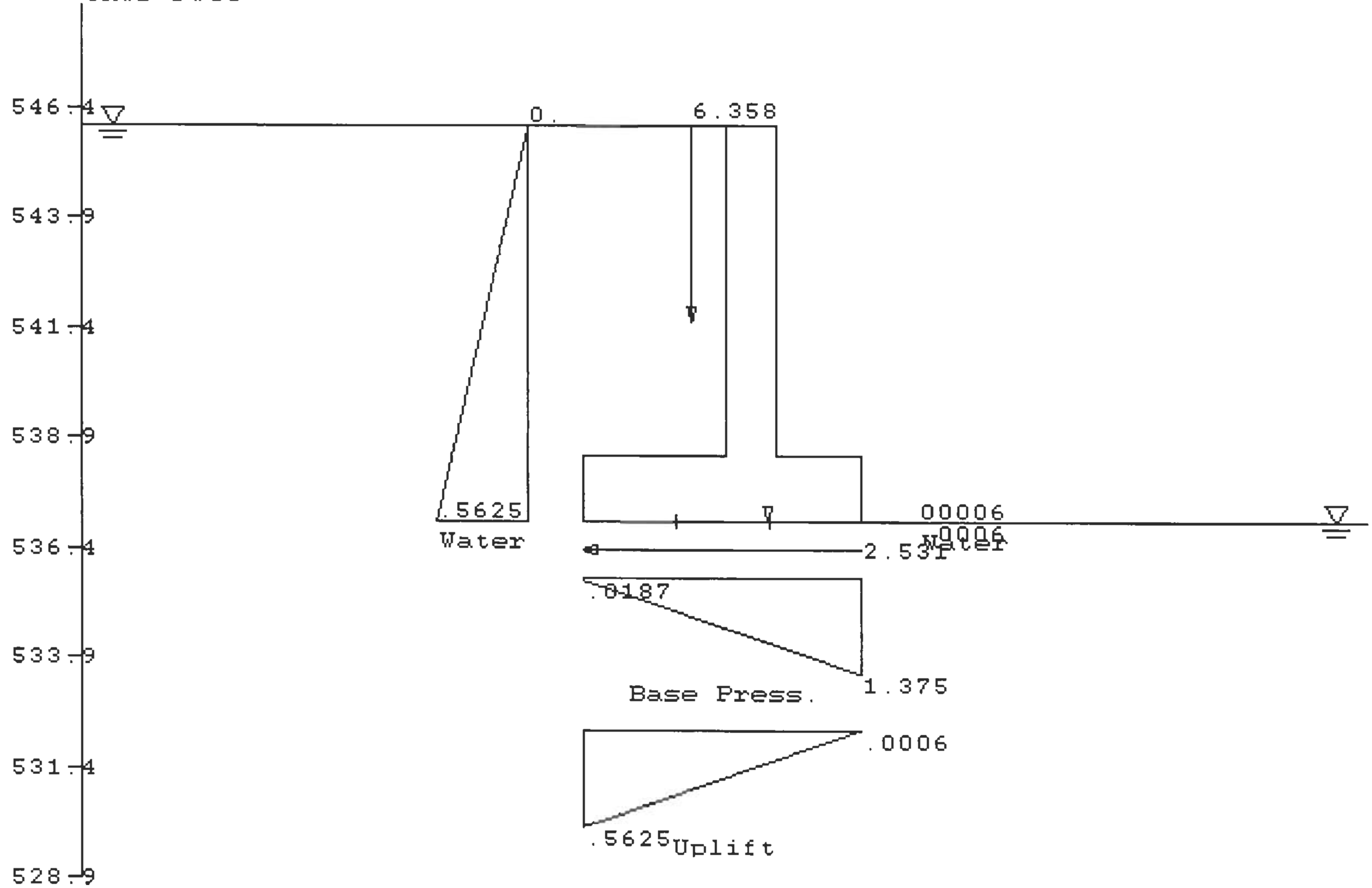
```
Angle of base         =      .00 degrees
Normal force on base =    4.528 kips
Shear force on base  =    2.531 kips
Max. available shear force =    6.500 kips

Base pressure at heel =    .0188 ksf
Base pressure at toe  =   1.3745 ksf

Xr (measured from toe) =     2.20 ft
Resultant ratio        =    .3378
Stem ratio             =    .3077
Base in compression    =   100.00 %
Overturning ratio      =     1.64

Volume of concrete =      .69 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        2.531         .333
     3         .000         .000

  Water pressures on wedges:

             Top       Bottom
    Wedge    press.    press.   x-coord.    press.
    number   (ksf)     (ksf)     (ft)        (ksf)
  ================================================
      1     .0000     .0000
      2                           .0000       .5625
      2                          6.5000       .0006
      3     .0000     .0000

Points of sliding plane:
  Point 1 (left),  x =       .00 ft,   y =   537.00 ft
  Point 2 (right), x =      6.50 ft,   y =   537.00 ft

Depth of cracking =     9.00 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     6.500     6.025     6.500      1.830
     3      .000      .000      .000      .000       .000

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

```
=======
          SUM =      .000

      +------------------------------+
      | Factor of safety =    2.568 |
      +------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Upper Level Retaining Walls: I4CL6UL
(6-ft clear height)

Construction condition

1. Long-term soil properties assumed

2. Fully drained soil on driving side

3. Passive soil pressure neglected on resisting side

4. 100 psf vertical surcharge pressure applied

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

Date: **/11/14 Time: 15.04.28

Flood Wall Stability Analysis Using CTWALL
Filename: I4CL6UL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

Structural geometry data:

Elevation of top of stem (ELTS)	=	546.00	ft
Height of stem (HTS)	=	7.50	ft
Thickness top of stem (TTS)	=	1.17	ft
Thickness bottom of stem (TBS)	=	1.17	ft
Dist. of batter at bot. of stem (TBSR)	=	.00	ft
Depth of heel (THEEL)	=	1.50	ft
Distance of batter for heel (BTRH)	=	.00	ft
Depth of toe (TTOE)	=	1.50	ft
Width of toe (TWIDTH)	=	2.00	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	537.00
.00	538.50
2.83	538.50
2.83	546.00
4.00	546.00
4.00	538.50
6.00	538.50
6.00	537.00

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:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Delta (deg)	Elev. soil (ft)
27.00	.000	.100	.130	.00	546.00

Driving side soil geometry:

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

Driving side soil profile:

Soil point	x (ft)	y (ft)
1	-1497.17	546.00
2	2.83	546.00

Resisting side soil property data:

Phi (deg)	c (ksf)	Moist Unit wt. (kcf)	Saturated unit wt. (kcf)	Elev. soil (ft)	Batter (in:1ft)
27.00	.000	.100	.130	537.00	.00

Resisting side soil profile:

Soil point	x (ft)	y (ft)
1	6.00	537.00
2	506.00	537.00

Foundation property data:
- phi for soil-structure interface = 27.00 (deg)
- c for soil-structure interface = .250 (ksf)
- phi for soil-soil interface = 27.00 (deg)
- c for soil-soil interface = .250 (ksf)

Water data:
- Driving side elevation = 537.01 ft
- Resisting side elevation = 537.01 ft
- Unit weight of water = .0625 kcf
- Seepage pressures computed are hydrostatic.

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

***************     *** Satisfied ***
* Overturning *     Required base in comp. =  75.00 %
***************     Actual base in comp.   = 100.00 %
                    Overturning ratio      =   2.22

Xr (measured from toe) =   2.00 ft
Resultant ratio        =  .3339
Stem ratio             =  .3333
Base pressure at heel =     .0030 ksf
Base pressure at toe  =    1.6864 ksf

***********     *** Satisfied ***
* Sliding *     Min. Required =   1.33
***********     Actual FS     =   1.56
```

********************** Output Results **********************

Date: **/11/14 Time: 15.04.28

Flood Wall Stability Analysis Using CTWALL
Filename: I4CL6UL.DAT

Company name:
CDM
Project name:
TRWD-FWCC
Project location:
Fort Worth, TX / Tarrant Regional Water District
Wall location:
Walls at bypass channel
Computed by: BDA

****
** Overturning Results **
****

Solution converged in 1 iterations.

SMF used to calculate K's = .6667
Alpha for the SMF = -54.4214
Calculated earth pressure coefficients:
Driving side at rest K = .5133
Driving side at rest Kc = .7164
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 (ft)	Pressure (ksf)
537.01	.0000
537.00	.0006

Earth pressures:

Elevation (ft)	Pressure (ksf)
546.00	.0000
537.01	.4614
537.00	.4618

```
  Surcharge pressures:
       Elev.   Press.
       (ft)    (ksf)
    ====================
       546.00     .051
       537.00     .051

** Resisting side pressures **

  Water pressures:
    Elevation   Pressure
      (ft)        (ksf)
    =======================
       537.01      .0000
       537.00      .0006
       537.00      .0006

** Uplift pressures **

  Water pressures:
     x-coord.   Pressure
       (ft)       (ksf)
    =======================
          .00      .0006
         6.00      .0006
```

** Forces and moments **

Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	2.666		-2.80	-7.45
Structure, driving side:				
Moist soil.................	2.123		-4.59	-9.73
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
External vertical loads....	.283		-4.59	-1.30
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......		2.079	3.00	6.24
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.462	4.50	2.08
Water loads................		.000	-.62	.00
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		.000	-.62	.00
Foundation:				
Vertical force on base.....	-5.068		-2.00	10.15
Shear on base..............		-2.541	.00	.00
Uplift.....................	-.004		-3.00	.01
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 5.068 kips
Shear force on base = 2.541 kips
Max. available shear force = 4.082 kips

Base pressure at heel = .0030 ksf
Base pressure at toe = 1.6864 ksf

Xr (measured from toe) = 2.00 ft
Resultant ratio = .3339
Stem ratio = .3333
Base in compression = 100.00 %
Overturning ratio = 2.22

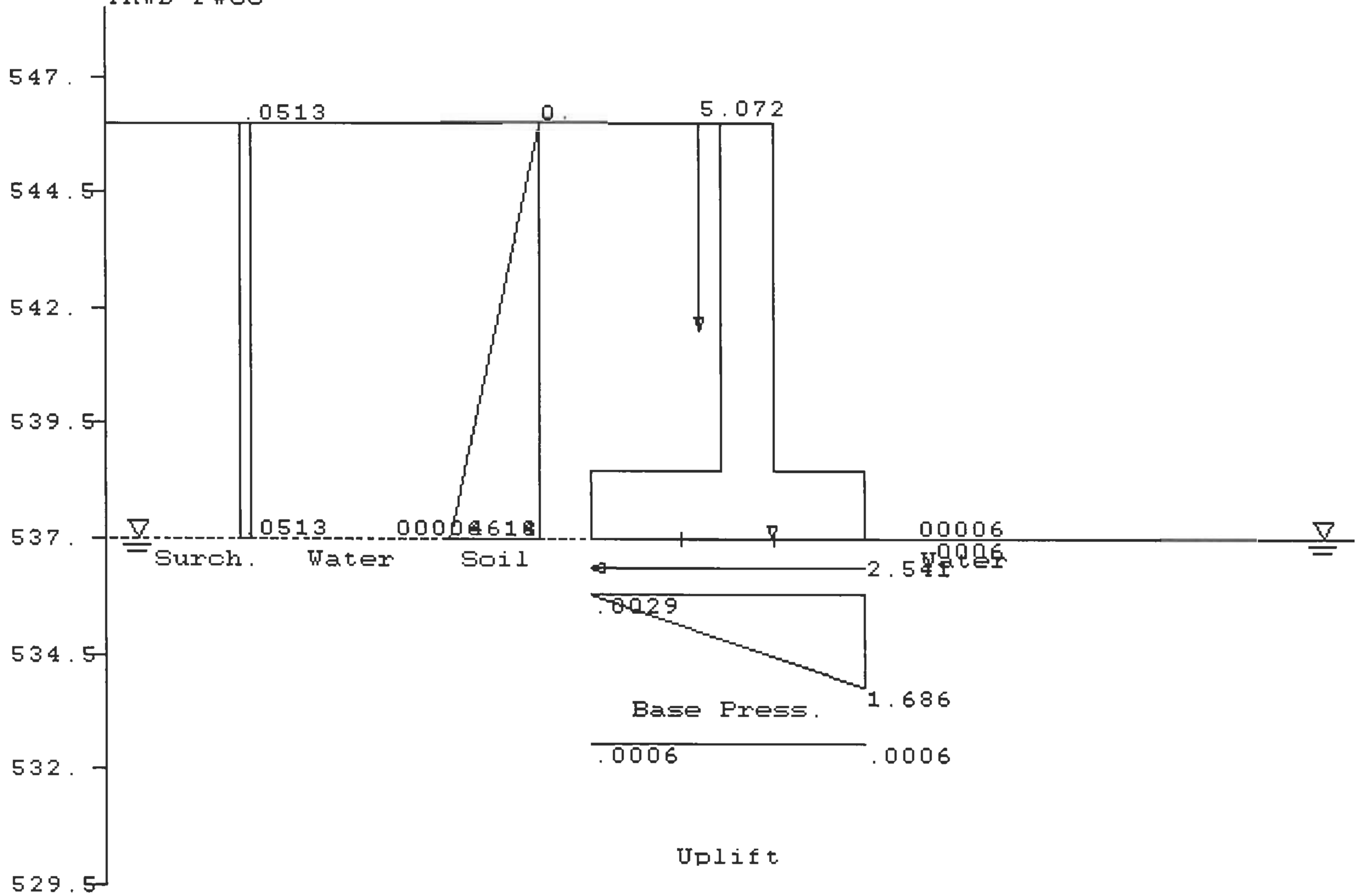
Volume of concrete = .66 cubic yds/ft of wall

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         .650
     2         .000         .283
     3         .000         .000

  Water pressures on wedges:

              Top       Bottom
    Wedge    press.    press.    x-coord.    press.
    number   (ksf)     (ksf)      (ft)       (ksf)
  ================================================
      1     .0000     .0006
      2                           .0000      .0006
      2                          6.0000      .0006
      3     .0000     .0000

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =     6.00 ft,   y =   537.00 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    -54.148   11.104      2.927       .012       .000
     2       .000    6.000      4.789      6.000       .004
     3       .000     .000       .000       .000       .000

  Wedge     Net force
  number     (kips)
  ===================
     1       -2.609
     2        2.609
     3         .000
  ===================
     SUM =     .000

+------------------------------
```

```
+
        | Factor of safety =     1.565 |
        +------------------------------+
```

Flood Wall Stability Analysis Using CTWALL
TRWD-FWCC



Section 4
Calculations for Retaining Walls
(Manual Calculations)

SEISMIC ANALYSIS

EFFECTIVE GROUND ACCELERATION BASED ON 2000 IBC (EQ 16-20 FOR $T_0 = 0$)

$$S_a = 0.40 S_{ds} = 0.40(0.12g) = 0.048g$$

SAY $0.05g$

PER EM 1110-2-2502 (3-26)

FOR $K_h = 0.05$ K_v CAN BE NEGLECTED $< 0.2g$

$$\psi = \tan^{-1}(K_h) = 2.86$$

FOR $K_v = \delta = \theta = \beta = 0°$

$$\phi_d = \tan^{-1}\left(\frac{\tan 27°}{1.1}\right) = 24.85°$$

(3-48)
$$K_{AE} = \frac{\cos^2(24.85° - 2.86)}{(\cos^2 2.86)\left[1 + \sqrt{\frac{\sin 24.85 \sin(24.85 - 2.86)}{\cos 2.86}}\right]^2}$$

$$= \frac{0.860}{0.998(1.95)}$$

$$= 0.442$$

(3-15) STATIC:
$$K_A = \frac{1 - \sin 24.85}{1 + \sin 24.85} = \frac{0.580}{1.420} = 0.408$$

$$\Delta K_{AE} = K_{AE} - K_A = 0.442 - 0.408 = 0.034$$

(3) Simplifying Conditions. For the usual case where k_v, δ, and θ are taken to be zero, the equations reduce to:

$$K_{AE} = \frac{\cos^2 (\phi - \Psi)}{\cos^2 \Psi \left[1 + \sqrt{\frac{\sin \phi \sin (\phi - \Psi - \beta)}{\cos \beta \cos \Psi}}\right]^2} \quad [3\text{-}48]$$

$$K_{PE} = \frac{\cos^2 (\phi - \Psi)}{\cos^2 \Psi \left[1 - \sqrt{\frac{\sin \phi \sin (\phi - \Psi + \beta)}{\cos \beta \cos \Psi}}\right]^2} \quad [3\text{-}49]$$

where

$$\Psi = \tan^{-1} (k_h)$$

and

$$P_{AE} = 1/2\ K_{AE} \gamma h^2$$

$$P_{PE} = 1/2\ K_{PE} \gamma h^2$$

For the case when the water table is above the backfill, P_{AE} and P_{PE} must be divided into static and dynamic components for computing the lateral forces. Buoyant soil weight is used for computing the static component below the water table, with the hydrostatic force added, and saturated soil weight is used for computing the dynamic component (see paragraph 3-26c(3)).

(4) Observations. General observations from using Mononobe-Okabe analysis are as follows:

(a) As the seismic inertia angle Ψ increases, the values of K_{AE} and K_{PE} approach each other and, for a vertical backfill face ($\theta = 0$), become equal when $\Psi = \phi$.

(b) The locations of P_{AE} and P_{PE} are not given by the Mononobe-Okabe analysis. Seed and Whitman (1970) suggest that the dynamic component ΔP_{AE} be placed at the upper one-third point, ΔP_{AE} being the difference between P_{AE} and the total active force from Coulomb's active wedge without the earthquake. The general wedge earthquake analysis described in paragraph 3-26c places the dynamic component ΔP_{AE} at the upper one-third point also, but computes ΔP_{AE} as being the difference between P_{AE} and the total active where

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

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 ($\delta = 0$), Equation 3-12 reduces to:

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

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

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

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

$$K_A = \frac{1 - \sin \phi}{1 + \sin \phi} = \tan^2 \left(45° - \frac{\phi}{2} \right) \qquad [3\text{-}15]$$

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.

CLIENT	TRWD	JOB NO.	42275	COMPUTED BY	BUH
PROJECT	FWCC	DATE CHECKED	11-18-04	DATE	11-16-04
DETAIL	FLOOD WALL SEISMIC	CHECKED BY	[illegible]	PAGE NO.	

SEISMIC ANALYSIS

EFFECTIVE GROUND ACCELERATION BASED ON 2000 IBC (EQ 16-20 FOR $T_0 = 0$)

$$S_a = 0.40 S_{ds} = 0.40(0.12g) = 0.048g$$

SAY 0.05g

PER EM 1110-2-2502 (3-26)

FOR $K_h = 0.05$ K_v CAN BE NEGLECTED $< 0.2g$

$$\psi = \tan^{-1}(K_h) = 2.86$$

FOR $K_v = \delta = \theta = \beta = 0°$

$$\phi_d = \tan^{-1}\left(\frac{\tan 27°}{1.1}\right) = 24.85°$$

(3-48)

$$K_{AE} = \frac{\cos^2(24.85° - 2.86)}{(\cos^2 2.86)\left[1 + \sqrt{\frac{\sin 24.85 \sin(24.85 - 2.86)}{\cos 2.86}}\right]^2}$$

$$= \frac{0.860}{0.998\ (1.95)}$$

$$= 0.442$$

(3-15) STATIC:

$$K_A = \frac{1 - \sin 24.85}{1 + \sin 24.85} = \frac{0.580}{1.420} = 0.408$$

$$\Delta K_{AE} = K_{AE} - K_A = 0.442 - 0.408 = 0.034$$

CASE: I3ESLL.DAT

INERTIA OF CONCRETE WALL PLUS SOIL MASS ABOVE HEEL $= K_h W$

$W = \underset{\text{STR}}{5.706^k} + \underset{\text{SOIL}}{21.575^k} = 27.28^K$

$I_{cs} = K_h W = 0.05\,(27.28) = 1.36^k$

NOTE:

FULL DEPTH, WATER FILLED CRACK.
SO NO LATERAL EARTH PRESSURE
AND NO DYNAMIC SOIL PRESSURE

ADD WALL INERTIA FORCE

APPLY 1.36^k @ $h/2 = 13.5/2 = 6.75'$ ABOVE BASE
$\Rightarrow$ EL $523.25'$

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.8438
16.00	.4875

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	5.706		-5.63	-32.14
Structure, driving side:				
Moist soil................	.000		.00	.00
Saturated soil............	21.575		-9.09	-196.01
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......		1.360	6.75	9.18
Structure, resisting side:				
Moist soil................	.000		.00	.00
Saturated soil............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.394		-.50	-.20
Driving side:				
Effective earth loads......		.000	.00	.00
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		5.695	4.50	25.63
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads................		-1.901	2.60	-4.95
Foundation:				
Vertical force on base.....	-17.025		-6.21	105.68
Shear on base..............		-5.154	.00	.00
Uplift.....................	-10.650		-8.71	92.80
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 17.025 kips
Shear force on base = 5.154 kips
Max. available shear force = 16.000 kips

Base pressure at heel = .3489 ksf
Base pressure at toe = 1.7792 ksf

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

Solution converged. Summation of forces = 0.

Wedge Number	Horizontal Loads (kips)	Vertical Loads (kips)
1	.000	.000
2	5.154	.394
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.0000		
2			.0000	.8438
2			16.0000	.4875
3	.0000	.0000		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 516.50 ft
Point 2 (right), x = 16.00 ft, y = 516.50 ft

Depth of cracking = 13.50 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	16.000	27.281	16.000	10.650
3	.000	.000	.000	.000	.000

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

```
+-----------------------------+
| Factor of safety =    3.104 |
+-----------------------------+
```

CASE: I3ELLL.DAT

INERTIA OF CONCRETE MASS PLUS SOIL MASS ABOVE HEEL $= K_h W$

$W = \underset{STR}{5.706^k} + \underset{SOIL}{21.575^k} = 27.28^k$ ✓

$I_{cs} = 0.05\,(27.28^k) = 1.36^k$

$P_{AE} = P_A + P_{ws} + \Delta P_{AE}$

$= \frac{1}{2} K_A \gamma_b h^2 + \frac{1}{2} \cancel{K_A} \gamma_w h^2 + \frac{1}{2} \Delta K_{AE} \gamma h^2$

$= \frac{1}{2}(0.408)\left(\frac{130-62.5}{1000}\right)(13.5)^2 + \frac{1}{2}(.0625)(13.5)^2$

$+ \frac{1}{2}(0.034)(0.130)(13.5)^2$

$= \underset{P_A}{2.51} + \underset{P_{ws}}{5.70} + \underset{\Delta P_{AE}}{0.40} = 8.61^k$ ✓

WEDGE NET FORCE $= 6.051^k$ (FROM CTWALL - F.S. = 1.10) ✓
FORCE CALCULATED FOR F.S. REQD.

NET ADD'L FORCE

$8.61^k + 1.36^k - 6.05 = \underline{3.92^k}$ ✓

$P_A + P_{ws} = 2.51^k + 5.7^k = 8.21^k$ ✓ $\Delta P_{AE} = 0.40^k$

TOTAL SEISMIC MOMENT

$M_s = 8.21\,(13.5'/3) + 0.40\,(.67)(13.5') + 1.36^k\,(13.5'/2)$

$= 36.95'^k + 3.62'^k + 9.18'^k$

$= 49.75'^k$ ✓

$\Delta M = 49.75'^k - (13.85'^k + 19.74'^k) = 16.16'^k$

$h_e = 16.16'^k / 3.92^k = \underline{4.12'}$

∴ APPLY 3.92^k @ 4.12' FROM BASE ⇒ EL 520.62'

CT WALL ANALYSIS

FOR USE W/ I3ELLL.DAT

Water pressures:

Elevation (ft)	Pressure (ksf)
524.30	.0000
516.50	.4875
516.50	.4875

** Uplift pressures **

Water pressures:

x-coord. (ft)	Pressure (ksf)
.00	.6807
16.00	.4875

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	5.706		-5.63	-32.14
Structure, driving side:				
Moist soil................	.000		.00	.00
Saturated soil............	21.575		-9.09	-196.01
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......		3.920	4.12	16.15
Structure, resisting side:				
Moist soil................	.000		.00	.00
Saturated soil............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil..........	.394		-.50	-.20
Driving side:				
Effective earth loads......		3.077	4.50	13.85
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads...............		4.495	4.39	19.74
Resisting side:				
Effective earth loads......		.000	.00	.00
Water loads...............		-1.901	2.60	-4.95
Foundation:				
Vertical force on base.....	-18.329		-5.71	104.67
Shear on base.............		-9.591	.00	.00
Uplift....................	-9.346		-8.44	78.89
** Statics Check ** SUMS =	.000	.000		.00

* RESISTING SIDE FORCES TO BE NEGLECTED FOR EQ ANALYSIS

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

Stationary solution. Static sum of forces.

Wedge Number	Horizontal Loads (kips)	Vertical Loads (kips)
1	.000	.000
2	2.019	.394
3	.000	.000

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.6807		
2			.0000	.6807
2			16.0000	.4875
3	.0000	.0000		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 516.50 ft
Point 2 (right), x = 16.00 ft, y = 516.50 ft

Depth of cracking = -1.26 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	-57.908	17.421	7.364	17.421	5.929
2	.000	16.000	27.281	16.000	9.346
3	.000	.000	.000	.000	.000

Wedge number	Net force (kips)
1	-6.051
2	7.926
3	.000
SUM =	1.875

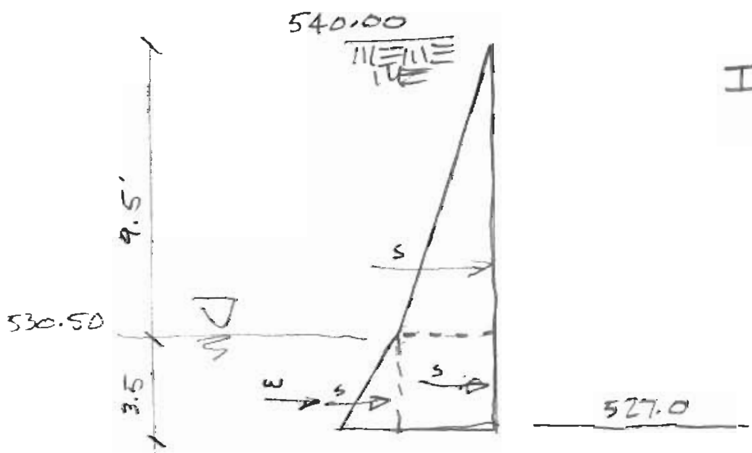
Wedge No. 2 Force > Wedge No. 1 Force, ok

NOTE: Forces are calculated for the FS specified below.

Factor of safety = 1.100

CDM	CLIENT TRWD	JOB NO. 42275	COMPUTED BY BDA
	PROJECT FWCC	DATE CHECKED 11-18-04	DATE 11-16-04
	DETAIL FLOOD WALL SEISMIC	CHECKED BY [illegible]	PAGE NO.

CASE: I3ELML.DAT



$W = 4.606^k + 8.864^k + 2.426^k$
$= 15.90^k$

$I_{cs} = 0.05\,(15.90^k)$
$= 0.79^k$

WEDGE NET FORCE $= 4.735^k$

$P_{AE} = \tfrac{1}{2} K_{aE}\, \gamma h^2$

$$P_{AE} = \tfrac{1}{2}(.442)(.100)(9.5)^2 + (.442)(.100)(9.5')(3.5') + \tfrac{1}{2}(.442)\left(\frac{130-62.5}{1000}\right)(3.5)^2 + \tfrac{1}{2}(62.5/1000)(3.5)^2$$

$= 1.99^k + 1.47^k + 0.18^k + 0.38^k$

$= 4.02^k$

$\Delta P_{AE} = 4.02^k - 4.735^k = -0.72^k$

NET ADD'L FORCE

$4.02^k + 0.79^k - 4.735^k = 0.075^k = 75^{lb}$ (SMALL)

NOTE: NEGLECT VERY SMALL NET ADDITIONAL FORCE DUE TO EARTHQUAKE. NO ADDITIONAL SURCHARGE LOAD REQUIRED.

CTWALL ANALYSIS
W/O EQ FORCES FOR
USE W/ I-3ELWL.DAT

** Forces and moments **

Part	Force (kips) Vert.	Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight..........	4.606		-3.92	-18.08
Structure, driving side:				
Moist soil................	8.864		-6.84	-60.58
Saturated soil............	2.426		-6.84	-16.58
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................	.150		-.50	-.08
Saturated soil............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil..........	.000		.00	.00
Driving side:				
Effective earth loads......		3.485	4.33	15.10
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		.297	1.17	.35
Resisting side:				
Effective earth loads......		-.835	1.00	-.84
Water loads................		.000	.24	.00
Foundation:				
Vertical force on base.....	-15.026		-4.86	73.07
Shear on base..............		-2.947	.00	.00
Uplift....................	-1.019		-7.50	7.64
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 15.026 kips
Shear force on base = 2.947 kips
Max. available shear force = 8.806 kips

* RESISTING SIDE FORCES TO BE NEGLECTED FOR EQ ANALYSIS

Base pressure at heel = .7016 ksf
Base pressure at toe = 1.9117 ksf

Xr (measured from toe) = 4.86 ft
Resultant ratio = .4228
Stem ratio = .0870
Base in compression = 100.00 %
Overturning ratio = 4.17

Volume of concrete = 1.14 cubic yds/ft of wall

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

Solution converged. Summation of forces = 0.

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

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.1695		
2			.0000	.1695
2			11.5000	.0077
3	.0000	.0077		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 527.00 ft
Point 2 (right), x = 11.50 ft, y = 527.00 ft

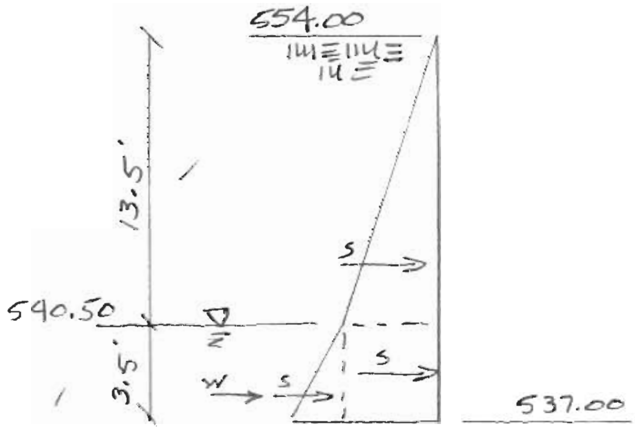
Depth of cracking = -.96 ft

Wedge number	Failure angle (deg)	Total length (ft)	Weight of wedge (kips)	Submerged length (ft)	Uplift force (kips)
1	-48.736	18.567	7.535	4.656	.395
2	.000	11.500	16.045	11.500	1.019
3	39.143	4.752	.553	.158	.001

Wedge number	Net force (kips)
1	-4.735
2	3.729
3	1.005
SUM =	.000

Factor of safety = 2.361

CASE I3EL14UL.DAT



$W = 8.374^k + 17.888^k + 2.877^k$
$= 29.139^k$

$I_{cs} = 0.05\,(29.139^k)$
$= 1.46^k$

WEDGE NET FORCE $= 9.237^k$

$P_{AE} = \frac{1}{2} K_{AE}\, \gamma\, h^2$

$$P_{AE} = \tfrac{1}{2}(.442)(.100)(13.5')^2 + (.442)(.100)(13.5')(3.5') + \tfrac{1}{2}(.442)\left(\frac{130-62.5}{1000}\right)(3.5)^2 + \tfrac{1}{2}\left(62.5/1000\right)(3.5)^2$$
$$= 4.03^k + 2.09^k + 0.18^k + 0.38^k$$
$$= 6.68^k$$

$\Delta P_{AE} = 6.68^k - 9.237^k = -2.56^k$

NET ADD'L FORCE
$6.68^k + 1.46^k - 9.237^k = \underline{-1.10^k}$

NOTE:

NEGLECT NEGATIVE NET ADDITIONAL FORCE DUE TO EARTHQUAKE. NO ADDITIONAL SURCHARGE LOAD REQUIRED.

CTWALL ANALYSIS
W/O EQ FORCES FOR
USE W/ I3ELI4UL.DAT

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	8.374		-5.09	-42.60
Structure, driving side:				
Moist soil.................	17.888		-9.38	-167.70
Saturated soil.............	2.877		-9.38	-26.97
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.................	.117		-.50	-.06
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
Driving side:				
Effective earth loads......		7.350	5.71	41.96
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		.314	1.16	.37
Resisting side:				
Effective earth loads......		-.598	.99	-.59
Water loads................		.000	-.10	.00
Foundation:				
Vertical force on base.....	-27.812		-6.48	180.24
Shear on base..............		-7.066	.00	.00
Uplift.....................	-1.443		-10.64	15.36
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 27.812 kips
Shear force on base = 7.066 kips
Max. available shear force = 18.171 kips

* RESISTING SIDE FORCES TO BE NEGLECTED FOR EQ ANALYSIS

Base pressure at heel = .7478 ksf
Base pressure at toe = 2.7288 ksf

Xr (measured from toe) = 6.48 ft
Resultant ratio = .4050
Stem ratio = .0625
Base in compression = 100.00 %
Overturning ratio = 4.12

Volume of concrete = 2.07 cubic yds/ft of wall

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

Solution converged.  Summation of forces = 0.

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

  Water pressures on wedges:

              Top      Bottom
    Wedge   press.    press.    x-coord.     press.
    number  (ksf)     (ksf)      (ft)        (ksf)
  ==============================================
      1     .0000     .1796
      2                           .0000       .1796
      2                         16.0000       .0007
      3     .0000     .0007

Points of sliding plane:
  Point 1 (left),  x =      .00 ft,   y =   537.00 ft
  Point 2 (right), x =    16.00 ft,   y =   537.00 ft

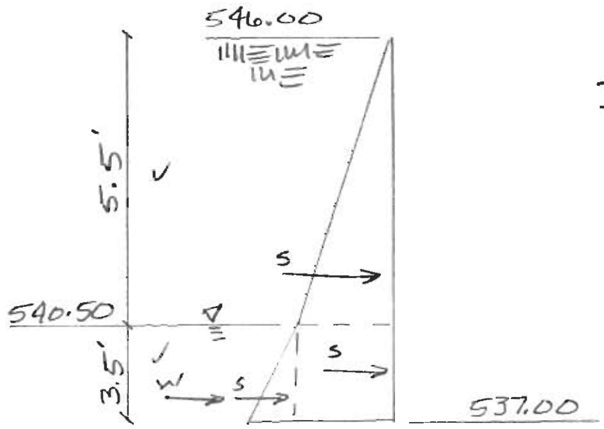
Depth of cracking =      .00 ft

          Failure   Total     Weight    Submerged   Uplift
  Wedge    angle    length   of wedge    length     force
  number   (deg)     (ft)     (kips)      (ft)      (kips)
  ====================================================
     1   -51.739   21.651    11.541     4.457       .400
     2      .000   16.000    29.255    16.000      1.443
     3    38.535    4.815      .565      .016       .000

  Wedge     Net force
  number     (kips)
  ==================
     1       -9.237
     2        8.514
     3         .722
  ==================
     SUM =    .000

+------------------------------+
| Factor of safety =    2.134 |
+------------------------------+
```

CASE: I3EL6UL.DAT



$W = 2.779^k + 2.382^k + 1.126^k$
$= 6.287^k$

$I_{es} = 0.05(6.287^k)$
$= 0.31^k$

WEDGE NET FORCE $= 2.788^k$

$P_{AE} = \frac{1}{2} K_{AE} \gamma h^2$

$P_{AE} = \frac{1}{2}(.442)(.100)(5.5)^2 + (.442)(.100)(5.5')(3.5')$
$+ \frac{1}{2}(.442)\left(\frac{130-62.5}{1000}\right)(3.5')^2 + \frac{1}{2}\left(\frac{62.5}{1000}\right)(3.5)^2$

$= 0.67^k + 0.85^k + 0.18^k + 0.38^k$
$= 2.08^k$

$\Delta P_{AE} = 2.08^k - 2.788^k = -0.70^k$

NET ADDIL FORCE
$2.08^k + 0.31^k - 2.788^k = \underline{-0.40^k}$

NOTE:
NEGLECT NEGATIVE NET ADDITIONAL FORCE DUE TO EARTHQUAKE. NO ADDITIONAL SURCHARGE LOAD REQUIRED.

CT WALL ANALYSIS
W/O EQ FORCES FOR
USE W/I3ELGUL.DAT

** Forces and moments **

Part	Force (kips) Vert.	Force (kips) Horiz.	Mom. Arm (ft)	Moment (ft-k)
Structure:				
Structure weight...........	2.779		-2.46	-6.84
Structure, driving side:				
Moist soil.................	2.382		-4.34	-10.32
Saturated soil.............	1.126		-4.33	-4.88
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.................	.150		-.50	-.08
Saturated soil.............	.000		.00	.00
Water above structure......	.000		.00	.00
Water above soil...........	.000		.00	.00
Driving side:				
Effective earth loads......		2.045	3.03	6.20
Shear (due to delta).......	.000		.00	.00
Horiz. surcharge effects...		.000	.00	.00
Water loads................		.249	1.16	.29
Resisting side:				
Effective earth loads......		-.598	1.01	-.60
Water loads................		.000	2.15	.00
Foundation:				
Vertical force on base.....	-5.970		-2.38	14.22
Shear on base..............		-1.696	.00	.00
Uplift.....................	-.466		-4.32	2.01
** Statics Check ** SUMS =	.000	.000		.00

Angle of base = .00 degrees
Normal force on base = 5.970 kips
Shear force on base = 1.696 kips
Max. available shear force = 4.667 kips

Base pressure at heel = .1827 ksf
Base pressure at toe = 1.6543 ksf

Xr (measured from toe) = 2.38 ft
Resultant ratio = .3665
Stem ratio = .1538
Base in compression = 100.00 %
Overturning ratio = 2.67

Volume of concrete = .69 cubic yds/ft of wall

* RESISTING SIDE FORCES TO BE NEGLECTED FOR EQ ANALYSIS

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

Solution converged. Summation of forces = 0.

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

Water pressures on wedges:

Wedge number	Top press. (ksf)	Bottom press. (ksf)	x-coord. (ft)	press. (ksf)
1	.0000	.1425		
2			.0000	.1425
2			6.5000	.0008
3	.0000	.0008		

Points of sliding plane:
Point 1 (left), x = .00 ft, y = 537.00 ft
Point 2 (right), x = 6.50 ft, y = 537.00 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	-51.452	11.508	3.374	4.475	.319
2	.000	6.500	6.436	6.500	.466
3	38.686	4.800	.562	.016	.000

Wedge number	Net force (kips)
1	-2.788
2	2.082
3	.706
SUM =	.000

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+-----------------------------+
| Factor of safety =    2.242 |
+-----------------------------+
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