NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

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SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY Ruth Kilowicz, Effie Mastorides CHECKED BY DATE 12-10-85, 9-26-86.

THOMASTON DAM

STABILITY COMPUTATIONS
APPENDIX B
[12-10-85 through 9-26-86]

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NOTE: The Results of these computations are contained in "REVIEW OF STRUCTURAL STABILITY — THOMASTON DAM"

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PAGE 1

SUBJECT THOMASTON DAM
COMPUTATION [illegible]
COMPUTED BY [illegible] CHECKED BY DATE 7-29-86

INTRODUCTION:

GIVEN: PLANS OF THOMASTON DAM
DESIGN MEMORANDA No. 1 Design Computations
No. 4 Geology & Soils
No. 7 Hydrology + Hydraulics.

CRITERIA USED:

1. EM 1110-1-2101 "Working Stresses for Structural Design" (1 Nov 1963) —with change 17 Jan 1972.
2. EM 1110-2-2200 "Gravity Dam Design" (25 Sept. 1958) — with Change 23 Nov 1960
3. EM 1110-2-2400 "Structural Design of Spillways and Outlet Works (2 Nov 1964)
4. EM 1110-2-2501 "Wall Design: Flood Walls" (Jan 1948) —with change 18 June 1962
5. EM 1110-2-2502 "Retaining Walls" (29 May 1961) — with change 25 Jan 1965
6. ETL 1110-2-256 "Sliding Stability for Concrete Structures" (24 June 1981)
7. ER 1110-2-1806 "Earthquake Design and Analysis for C&E Dams (16 May 1983)
8. WORKING DRAFT "Retaining and Flood Wall Manual".

REQUIRED: Review the following elements of THOMASTON DAM with respect to current stability criteria listed above.

1. Spillway Weir
2. Spillway Training Walls
3. Control Tower
4. Outlet Works: Intake Channel Retaining Walls
5. Outlet Works: Outlet Channel Retaining Walls
6. Service Bridge Abutment

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY ENestorides CHECKED BY DATE 9-29-86

BACKGROUND MATERIAL

1. Spillway – Loading Conditions See EM 1110-2-2400 p.8
1110-2-2200 p.7

Case I Construction Condition
II Normal Operating Conditions
III Induced Surcharge Condition – NOT APPLICABLE –
IV Flood Discharge Condition
V Construction with earthquake Condition
VI Normal Operating with earthquake Condition

2. Spillway Training Walls. See EM 1110-2-2400 p.12
EM 1110-2-2502

Case I Channel Empty. Backfill Submerged to line of drains naturally drained above.
II Partial Sudden drawdown of reservoir from design elevation.
III Sudden rise of reservoir to design flood elevation.
IA Same as case one but with earthquake.

3. Control Tower See EM 1110-2-2400 p.25

Case I Reservoir Empty, dead Load of structure, earth load, wind load.

Case V Reservoir at spillway elevation. No flow in conduit. Dead Load of structure, 100% uplift.
Case IA Same as case I but with earthquake.

4. Intake Channel } Retaining Walls. see EM-1110-2-2400
Outlet Channel }

Case II } Backfill modeled as upstream pool.
Case VI } see Spillway loading.

5. Service Bridge Abutment.

Case I – Normal Operating condition, No water load, Backfill dry.
Case II – Rapid Drawdown from spillway elevation flood condition. Water trapped behind abutment.
Case III – Same as Case I but with earthquake.

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY E Nestorides CHECKED BY DATE 9-26-86

HYDRAULIC DATA

Full Pool condition → Spillway crest el. 494.0
no tail water downstream.

Design Discharge Condition → Reservoir at spillway crest and maximum surcharge at el. 512.00, no tailwater downstream.

ORIGINAL COMPUTATIONS (1956) vs PRESENT ANALYSIS (1986)

1. Earthquake forces were not considered in the original comps, except for control tower where a = 0.05g was used.
   ETL 1110-2-1806 now requires earthquake accelerations = 0.1g

2. Original Computations for Sliding factor of safety were done using the sliding resistance method ΣH/ΣV.
   ETL 1110-2-256 now requires single or multiple wedge analysis.

3. Original design of service bridge and abutment varied from the "as-built" drawings. The present stability analysis was carried out using the as-built sections with foundation and soil parameters from the original design memoranda.

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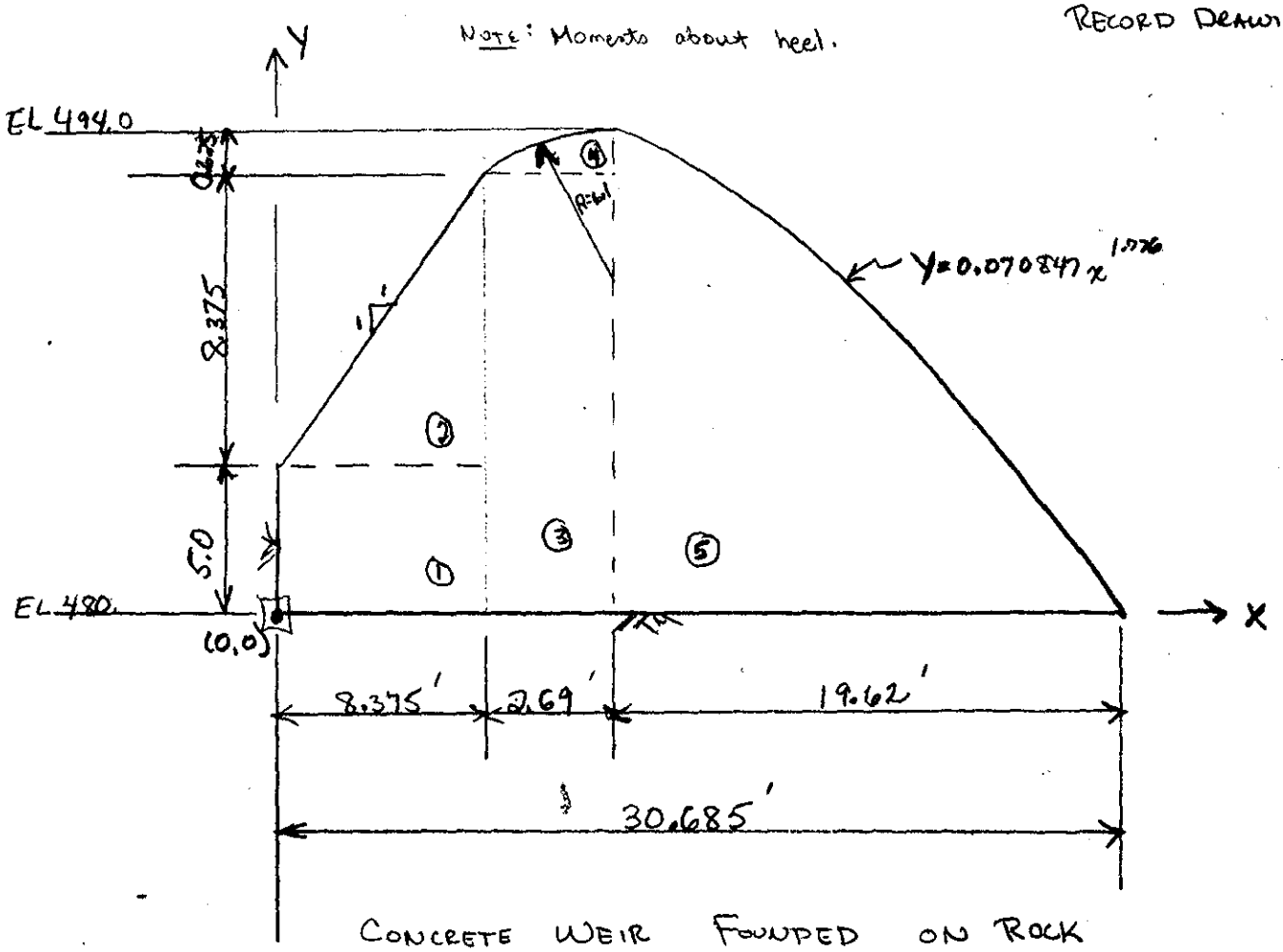
SUBJECT: THOMASTON DAM - STABILITY ANALYSIS
COMPUTATION: OGEE SECTION ① (NO ANCHORS) - MASS CENTER CALC.
COMPUTED BY: RK CHECKED BY: DATE: 12/10/85

CONSIDER TYPICAL SPILLWAY SECTION - SEE SH. 44 OF AS-BUILT RECORD DRAWINGS.

NOTE: Moments about heel.



CONCRETE WEIR FOUNDED ON ROCK

AREA ①

$\bar{x}_1' = \bar{x}_1 = 8.375/2 = \underline{4.1875'}$

$\bar{y}_1' = \bar{y}_1 = \underline{2.5'}$

$A_1 = 5 \times 8.375 = \underline{41.875\ ft^2}$

AREA ②

$\bar{x}_2 = 2/3(8.375) = \underline{5.583'}$

$\bar{y}_2 = 5.0 + 8.375/3 = \underline{7.79'}$

$A_2 = 1/2(8.375)(8.375) = \underline{35.07\ ft^2}$

SUBJECT THOMASTON
COMPUTATION Ogee Section - Area + Mass Centers Calcs
COMPUTED BY RKO CHECKED BY DATE 12/10/85

X-SECT ① - MASS CENTER AND AREA CALCS

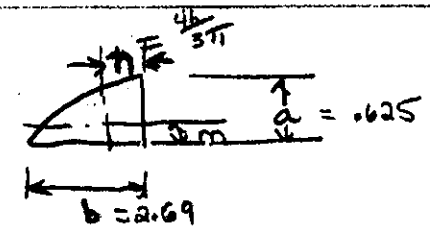
AREA ③

$$\bar{X}_3 = 8.375 + \frac{2.69}{2} = 9.72'$$

$$\bar{Y}_3 = \frac{8.375 + 5.0}{2} = 6.6875'$$

$$A_3 = 2.69 \times 13.375 = 35.98 \text{ ft}^2$$

AREA ④ - approx 1/4 ellipse



$$\bar{X}_4 = 8.375 + \left[2.69 - \frac{4b}{3\pi}\right]$$

$$= 8.375 + \left[2.69 - \frac{4(2.69)}{3\pi}\right] = 9.92'$$

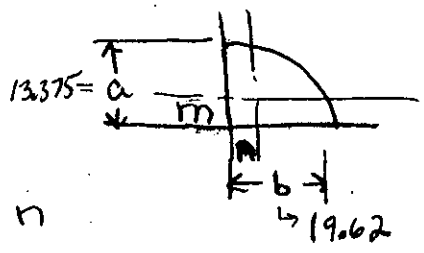
$$\bar{y}_4 = 13.375 + m$$

$$= 13.375 + \frac{4(0.625)}{3\pi} = 13.64'$$

$$A_4 = \frac{1}{4}\pi ab$$

$$= \frac{1}{4}\pi(0.625)(2.69) = 1.32 \text{ ft}^2$$

AREA ⑤ half parabola



$$\bar{X}_5 = 8.375 + 2.69 + n$$

$$= 11.065 + \tfrac{3}{8}(19.62) = 18.42'$$

$$\bar{y}_5 = m = \tfrac{2}{5}a = \tfrac{2}{5}(13.375) = 5.35'$$

$$A_5 = \tfrac{2}{3}ab = 174.95 \text{ ft}^2$$

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NEW ENGLAND DIVISION
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SUBJECT: THOMASTON
COMPUTATION: MASS CENTER + AREA
COMPUTED BY: RK CHECKED BY: DATE: 12/10/85

X-SECT ① - MASS CENTER + AREA CALC.

MASS CENTER:

$$\bar{x} = \frac{\Sigma A_i \bar{x}_i}{\Sigma A_i}, \quad \bar{y} = \frac{\Sigma A_i \bar{y}_i}{\Sigma A_i}$$

Section	$\bar{x}_i$ (ft)	y_i (ft)	A_i (ft²)	$A_i x_i$ (ft³)	$A_i y_i$ (ft³)
1	4.188	2.5	41.875	175.37	104.69
2	5.583	7.79	35.07	195.80	273.20
3	9.72	6.688	35.98	349.73	240.63
4	9.92	13.64	1.32	13.10	18.00
5	18.42	5.35	174.95	3222.58	935.98
			289.20	3956.58	1572.50

$$\bar{x} = \frac{3956.58}{289.20} = 13.68 \text{ ft}$$

$$\bar{y} = \frac{1572.50}{289.20} = 5.44 \text{ ft}$$

$$A = 289.20 \text{ ft}^2$$

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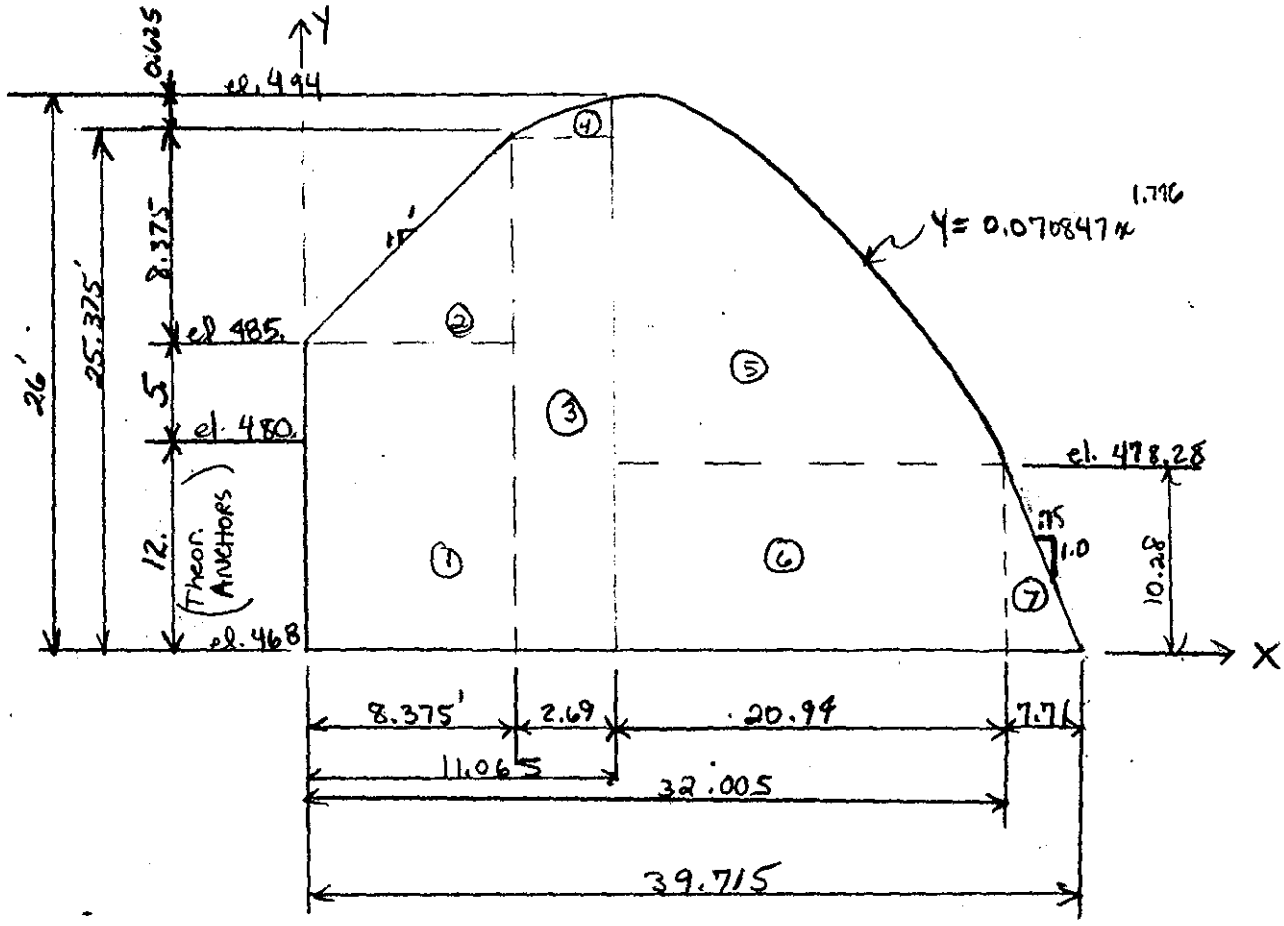
PAGE

SUBJECT: THOMASTON DAM STABILITY
COMPUTATION: Ogee Section (2) - w/ Anchors modeled as concrete
COMPUTED BY: RK CHECKED BY: DATE: 12/16/85



CONCRETE WEIR FOUNDED ON ROCK

Area (1)

$\bar{X}_1 = 8.375/2 = \underline{4.1875'}$

$\bar{Y}_1 = 17/2 = \underline{8.5}$

$A_1 = 17 \times 8.375 = \underline{142.375}\ ft^2$

Area (2)

$\bar{X}_2 = 2/3(8.375') = \underline{5.58}$

$\bar{Y}_2 = 17 + 1/3(8.375) = \underline{19.79}$

$A_2 = 1/2(8.375)^2 = \underline{35.07}$

SUBJECT THOMASTON
COMPUTATION Ogee Sect (2)
COMPUTED BY RK CHECKED BY DATE 12/16/85

X-SECTION (2) – Mass center AND AREA

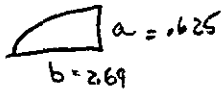
Area (3)

$$\bar{X}_3 = 8.375 + \frac{2.69}{2} = \underline{9.72}$$

$$\bar{y}_3 = \frac{25.375}{2} = \underline{12.69}$$

$$\bar{A}_3 = 2.69 \times 25.375 = \underline{68.26}$$

Area (4) – approx. 1/4 ellipse



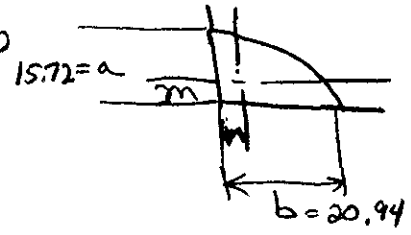
$$\bar{X}_4 = 8.375 + \left[\overset{(b - n)}{2.69 - \frac{4b}{3\pi}}\right] = \underline{9.92}$$

$$\bar{y}_4 = 25.375 + \frac{4\overset{a}{(.625)}}{3\pi} = \underline{25.64}$$

$$A_4 = \frac{1}{4}\pi ab$$

$$= \frac{1}{4}(\pi)(2.69)(.625) = \underline{1.32\ ft^2}$$

AREA (5) – approx. half parabola



$$\bar{X}_5 = 11.065 + \tfrac{3}{8}(20.94) = \underline{18.92}$$

$$\bar{y}_5 = 10.28 + \tfrac{2}{5}(15.72) = \underline{16.57}$$

$$A_5 = \tfrac{2}{3}(15.72)(20.94) = \underline{219.45}$$

SUBJECT THOMASTON
COMPUTATION Ogee Section ②
COMPUTED BY RVL CHECKED BY DATE 12/16/85

X-SECTION ② – MASS CENTER AND AREA CALC'S

AREA ⑥

$$\bar{X}_6 = 11.065 + \frac{20.94}{2} = \underline{21.54'}$$

$$\bar{y}_6 = \frac{10.28}{2} = 5.14$$

$$A_6 = 20.94 \times 10.28 = \underline{215.26\ ft^2}$$

AREA ⑦

$$\bar{X}_7 = 32.005 + 1/3(7.71) = \underline{34.57'}$$

$$\bar{Y}_7 = 1/3(10.28) = \underline{3.43'}$$

$$A_7 = 1/3(7.71)(10.28) = \underline{26.42\ ft^2}$$

SUBJECT Thomaston Dam
COMPUTATION Mass Center Section (2)
COMPUTED BY RK CHECKED BY DATE 12/16/55

K-SECT (2) - MASS CENTER AND AREA CALC.

MASS CENTER

$$\bar{x} = \frac{\Sigma A_i \bar{x}_i}{\Sigma A_i} \quad ; \quad \bar{y} = \frac{\Sigma A_i \bar{y}_i}{\Sigma A_i}$$

SECTION	$\bar{X}_i$	$\bar{Y}_i$	$\bar{A}_i$	$A_i X_i$	$A_i y_i$
1	4.1875	8.5	142.375	596.20	1210.19
2	5.58	19.79	35.07	195.69	694.04
3	9.72	12.69	68.26	663.49	866.22
4	9.92	25.64	1.32	13.09	33.84
5	18.92	16.57	219.45	4151.99	3636.29
6	21.54	5.14	215.26	4636.7	1106.44
7	34.57	3.43	26.42	913.34	90.62
			$\Sigma = 708.15$	$\Sigma = 11170.5$	$\Sigma = 7637.64$

$$\bar{x} = \frac{11170.5}{708.15} = \underline{15.77}\ ft$$

$$\bar{y} = \frac{7637.64}{708.15} = \underline{10.79}\ ft$$

Volume = 708.15 ft^3 (711.98)
Weight = 106.2^k (106.80)

TABLE 2

STABILITY ANALYSIS OF SPILLWAY WEIR

SECTION (1)	LOADING CASE	LOCATION OF RESULTANT IN MIDDLE THIRD	SLIDING FACTOR OF SAFETY (2)	LENGTH OF BASE IN BEARING (ft)	BEARING PRESSURE ON ROCK KIPS/S.F. UPSTREAM	DOWNSTREAM
TYPICAL SECT. at base El. 480.0	I	YES	893.43	30.69	1.91	0.92
Ht = 14.0 ft.	II	YES	60.33	30.69	1.12	1.01
Base = 30.69 ft	III	LOAD CASE III NOT APPLICABLE				
	IV	YES	21.88	30.69	0.44	0.34
	V	YES	78.83	30.69	2.06	0.77
	VI	YES	33.22	30.69	0.94	1.18
TYPICAL SECT. at base El. 468.0	I	YES	655.02	39.72	4.27	1.11
Ht = 26.0 ft.	II	YES	23.48	39.72	2.14	1.74
Base = 39.72 ft.	III	LOAD CASE III NOT APPLICABLE				
	IV	YES	12.71	39.72	0.60	1.17
	V	YES	44.58	39.72	4.70	0.68
	VI	YES	14.55	39.72	1.62	2.26

(1) SEE PLATES

(2) FACTOR OF SAFETY COMPUTED WITH BOND SHEAR VALUE OF 80 PSI AND COEFFICIENT OF FRICTION OF 0.5.

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SUBJECT Thomaston Dam Stability Analysis
COMPUTATION Summary Table of Weir Stability
COMPUTED BY
CHECKED BY
DATE
PAGE 11

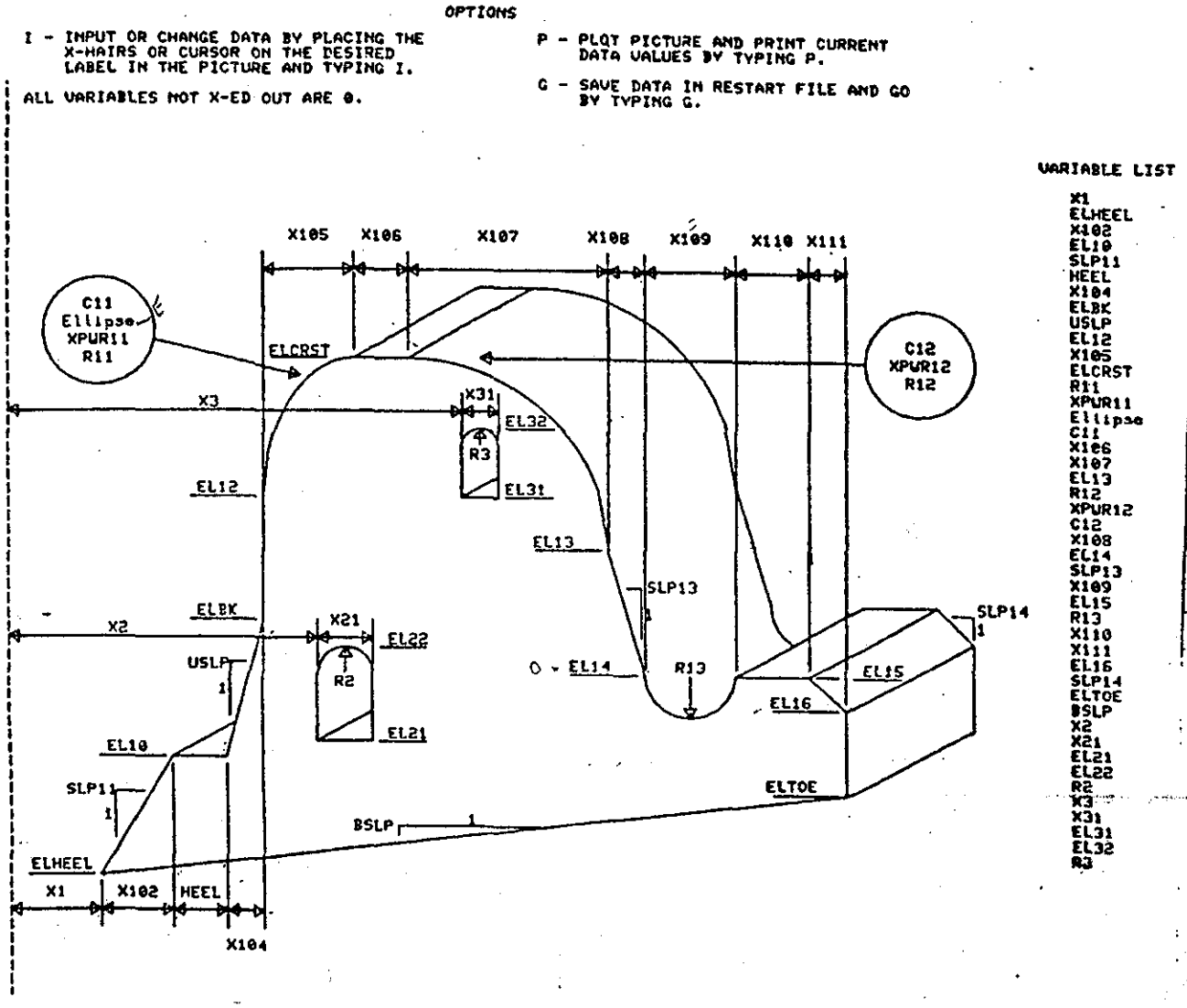

Figure 3. Overflow

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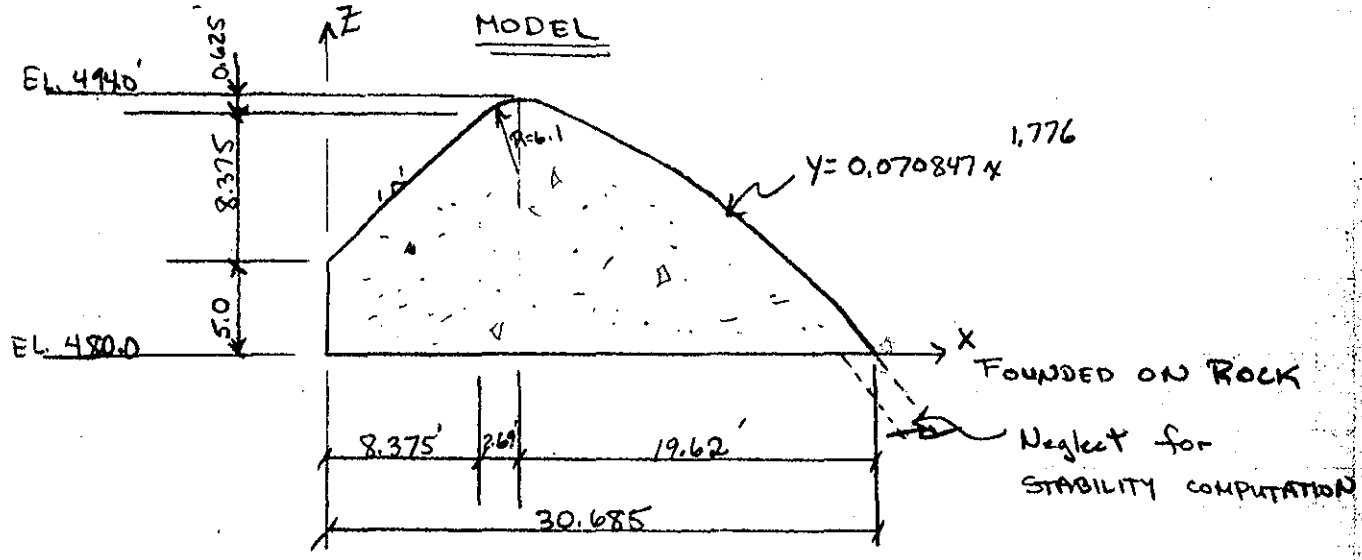
SUBJECT: THOMASTON STABILITY
COMPUTATION: COMPUTER MODEL - X-SECTION ① & INPUT
COMPUTED BY: RK CHECKED BY: DATE: 12/85

MODEL



COMPUTER INPUT - REF: COMPUTER AIDED STABILITY ANALYSIS OF CONCRETE HYDRAULIC STRUCTURES - CDAMS
SEE NEXT PAGE FOR X-SECTION DETAILS

* INPUT

```
10  THOMASTON DAM STABILITY
20  20  26.56  11.52
30  Φ
40  Φ  Φ  Φ
50  Φ
60  Φ  Φ  Φ
70  Φ.0625  Φ.Φ3  Φ.1
80  14.  Φ
90  Φ  Φ
100  32  22
110  OVERFLOW  1.  Φ.15  Φ
120  Φ  Φ
130  Φ  Φ  Φ  5  Φ
140  Φ  8.375  13.375  1
150  13.375  2.69  14  6.1  Φ Φ Φ E
160  Φ  19.62  Φ.Φ1  Φ  1.776  14.115
170  Φ  Φ.Φ1  Φ
180  Φ  Φ.Φ1  Φ
190  Φ  Φ  Φ.Φ1  Φ
200  Φ  Φ
210  Φ Φ  Φ Φ
220  Φ  Φ  Φ Φ
230  Φ  Φ
```

* Note: UNITS ARE feet and Kips.

VARIABLES

TITLE
Allow bearing φ shear strength
elev. of upstream soil layer
γ_{DRY} $\gamma_{BUOY.}$ K
elev. of downstream soil layer
γ_{DRY} γ_{BUOY} K
γ_{water} wind pressure seismic coeff.
normal headwater elev. tailwater elev.
Induced surcharge headwater elev. tailwater elev.
flood headwater elev. tailwater elev.
~~X section type~~ depth unit wt. No. of galleries
XDRAIN % effective
X1 ELHEEL X102 EL10 SLP11
HEEL X104 XELBK USLP
EL12 X105 ELCREST R11 XPWR11 C11 E
X106 X107 EL13 R12 XPWR12 C12
X108 EL14 SLP13
X109 EL15 R13
X110 X111 EL16 SLP14
ELTOE BSLP
Anchor load XAnchor YAnchor ELanchor
Misc load XMISC YMISC ELMISC
ICE LOAD THICKNESS

THOMASTON DAM WEIR STABILITY

X SECTION (1) (NO ANCHORS)

```
10  THOMASTON DAM STABILITY
20 20 26.56 11.52   (Allow bearing)  (φ)  (shear strength)
30 0 (Elev of upstream soil layer)
40 0 0 0 (γDRY) (γBUOY) (K)
50 0 (Elev. of downstream soil layer)
60 0 0 0 (γDRY) (γBUOY) (K)
70 .0625 .03 .1 (γwater) (wind pressure) (seismic coeff.)
80 14 0  (normal headwater elev) (tailwater elev)
90 0 0  (Induced surcharge headwater elev)  (tailwater elev)
100 32 22 (flood headwater elev)  (tailwater elev)
110 OVERFLOW 1 .15 0 (overflow) (depth)  (unit wt)  (No. of gillenies)
120 0 0   (XDRAIN)  (% effec)
130 0 0 0 5 0  (X1)  (ELHEEL)  X102  EL10  SLP11
140 0 8.375 13.375 1  HEEL  X104  XELBK  USLP
150 13.375 2.69 14 6.1 0 0 0 E  EL12  X105  BLREST  R11  XPWR11  C11  E
160 0 19.62 .01 0 1.776 14.115  X106  X107  EL13  R12  XPWR12  C12
170 0 .01 0  X108  EL14  SLP13
180 0 .01 0  X109  EL15  R13
190 0 0 .01 0  X110  X111  EL16  SLP14
200 0 0  ELTOE  RSLP
210 0 0 0 0  Anchor load  XAnchor  YAnchor  ELAnchor
220 0 0 0 0  Misc load  XMISC  YMISC  ELMISC
230 0 0  ICE LOAD  THICKNESS
/
OLD,CORPS/UNCECELB
BRSIN,,CORPS,X210φ
```

LOAD CASE I CATEGORY = 2

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	-.420	FY =	0.000	FZ =	-43.430
MX =	-21.7	MY =	589.0	MZ =	.2

INPUT COORDINATES AND UPLIFT VALUES

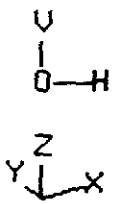
NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	30.685	0.000	0.000	0.000
C	30.685	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT
		DENSITY =	.0625		

COMMAND ?
? FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	-.42 -21.72	0.00 589.01	-43.43 .21

COMMAND ?
?



SF = 2.48 UNITS/INCH

LOAD CASE I
CATEGORY = 2

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = -1.78
Y ECC. = .00

R DIST = .11

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 2.82 UNITS/INCH

LOAD CASE I CATEGORY = 2

FINAL BASE AREA PROPERTIES

AREA =	30.685	IXP =	2.6	IYP =	2407.7
XBAR =	15.343	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	-.420	FY =	0.000	FZ =	-43.430
MX =	-21.7	MY =	589.0 (557)	MZ =	.2

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	-.420	FY =	0.000	FZ =	-43.430
MX =	-21.7	MY =	589.0	MZ =	.2

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	1.907
B	30.685	0.000	0.000	.922
C	30.685	1.000	0.000	.924
D	0.000	1.000	0.000	1.909

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 180.00

FACTOR OF SAFETY = 893.43

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

Spot (1)

LOAD CASE II CATEGORY = 1

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	6.130	FY =	0.000	FZ =	-45.980
MX =	-23.0	MY =	628.3	MZ =	-3.1

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	.875
B	30.685	0.000	0.000	0.000
C	30.685	1.000	0.000	0.000
D	0.000	1.000	0.000	.875

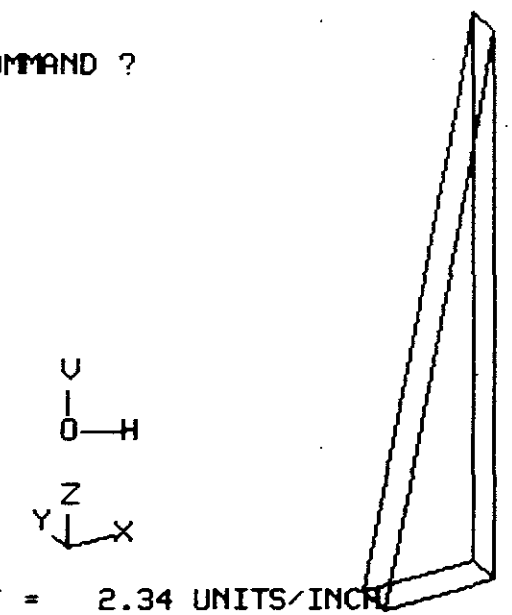
PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT

DENSITY = .0625

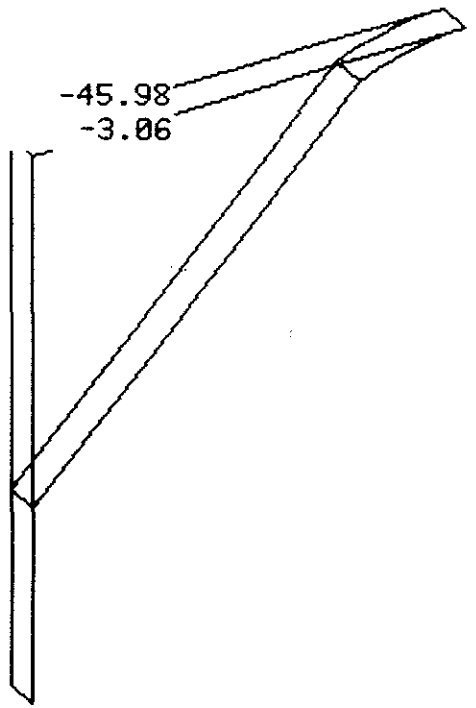
COMMAND ?
? FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	6.13 -22.99	0.00 628.33	-45.98 -3.06

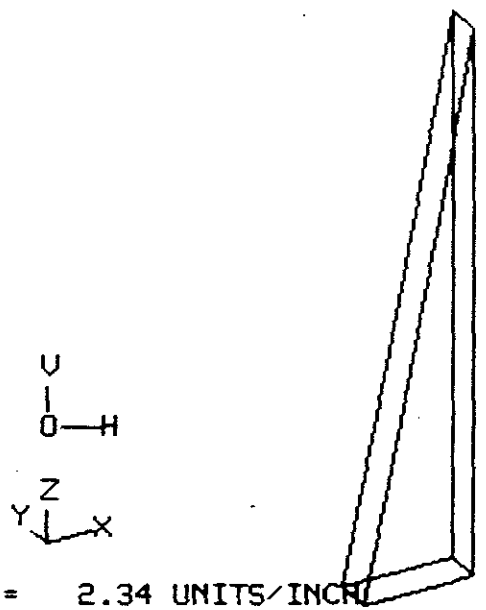
COMMAND ?
?



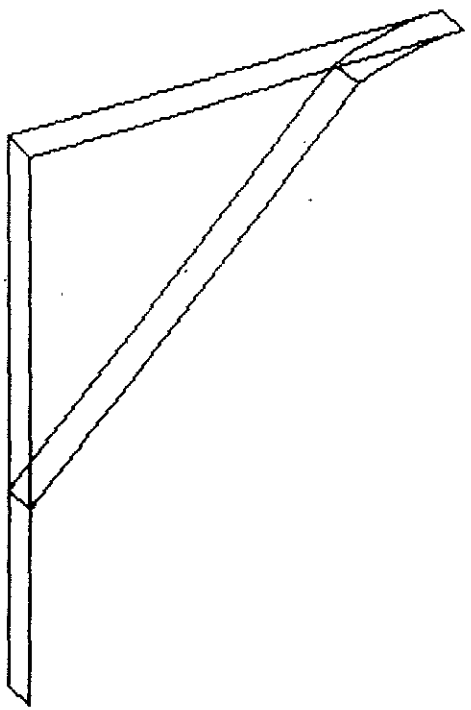
SF = 2.34 UNITS/INCH



COMMAND ?



SF = 2.34 UNITS/INCH



LOAD CASE II
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

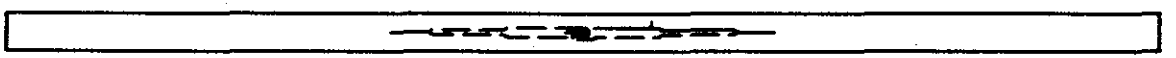
X ECC. = -.26
Y ECC. = 0.00

R DIST = .16

YG
ZG—XG

YL
XL

SF = 2.82 UNITS/INCH



LOAD CASE II CATEGORY = 1

FINAL BASE AREA PROPERTIES

AREA =	30.685	IXP =	2.6	IYP =	2407.7
XBAR =	15.343	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	6.130	FY =	0.000	FZ =	-45.980
MX =	-23.0	MY =	628.3	MZ =	-3.1

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	13.425
MX =	6.7	MY =	-137.3	MZ =	0.0

--TOTAL--

FX =	6.130	FY =	0.000	FZ =	-32.555
MX =	-16.3	MY =	491.0	MZ =	-3.1

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	1.115
B	30.685	0.000	0.000	1.007
C	30.685	1.000	0.000	1.007
D	0.000	1.000	0.000	1.115

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FACTOR OF SAFETY = 60.33

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

Sect (1)

Similar to case III in DM 7.

LOAD CASE IV CATEGORY = 2

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

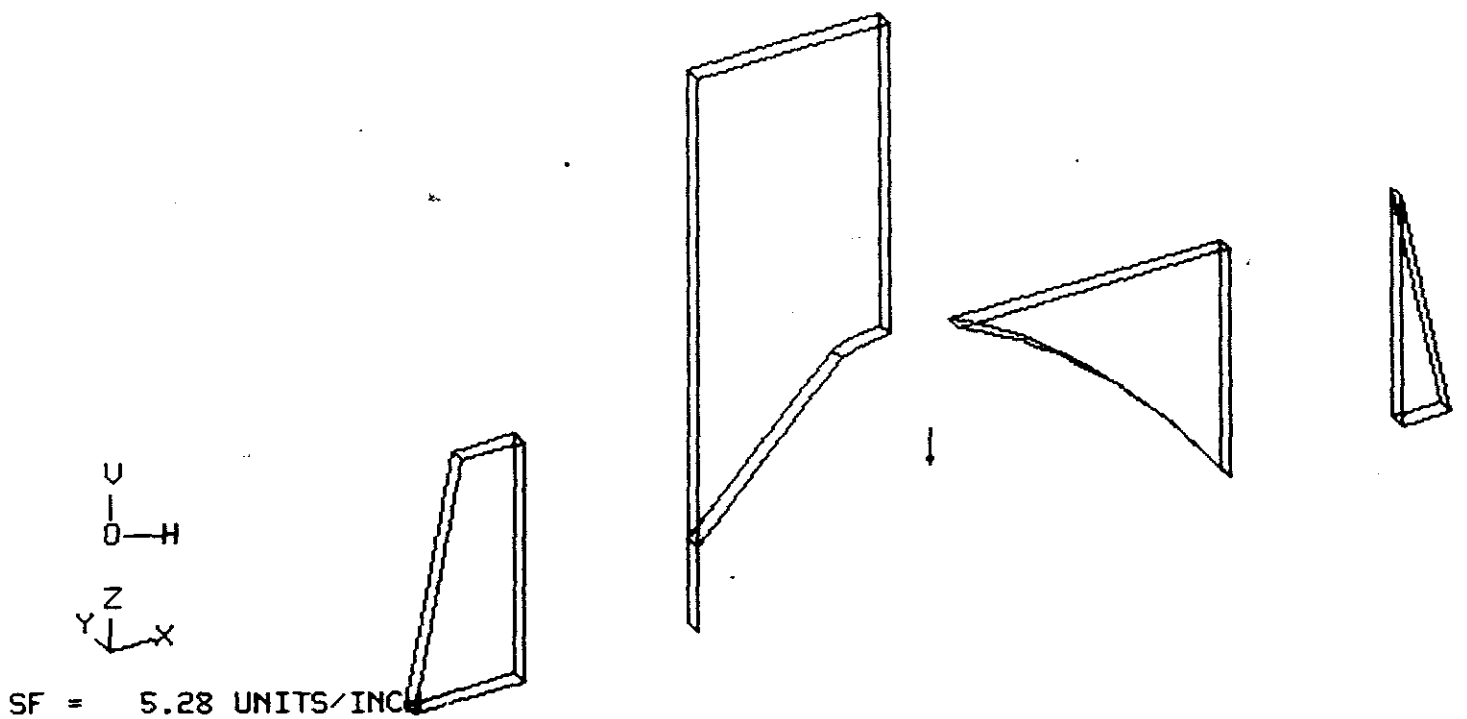
FX =	16.430	FY =	0.000	FZ =	-63.770
MX =	-31.9	MY =	922.2	MZ =	-8.2

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	2.000
B	30.685	0.000	0.000	1.375
C	30.685	1.000	0.000	1.375
D	0.000	1.000	0.000	2.000

PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT
		DENSITY =	.0625		

COMMAND ?
?



SF = 5.28 UNITS/INCH

LOAD CASE IV
CATEGORY = 2

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

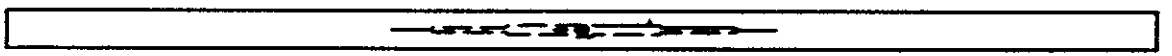
X ECC. = -.60
Y ECC. = -.00

R DIST = .15

```
YG
|
ZG—XG

YL
└—XL
```

SF = 2.82 UNITS/INCH



LOAD CASE IV CATEGORY = 2

FINAL BASE AREA PROPERTIES

AREA =	30.685	IXP =	2.6	IYP =	2407.7
XBAR =	15.343	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	16.430	FY =	0.000	FZ =	-63.770 + 43.4 wc = 20.31 uplift
MX =	-31.9	MY =	922.2	MZ =	-8.2

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	51.781 @ elev 512 (48.75)
MX =	25.9	MY =	-745.4	MZ =	0.0 @ elev 509

--TOTAL--

FX =	16.430	FY =	0.000	FZ =	-11.989
MX =	-6.0	MY =	176.8	MZ =	-8.2

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	.437
B	30.685	0.000	0.000	.346
C	30.685	1.000	0.000	.344
D	0.000	1.000	0.000	.435

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FACTOR OF SAFETY = 21.88

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

Sect (1)

LOAD CASE V CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	-4.760	FY =	0.000	FZ =	-43.430
MX =	-21.7	MY =	565.2	MZ =	2.4

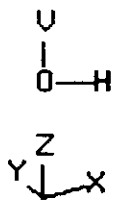
INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	30.685	0.000	0.000	0.000
C	30.685	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT

DENSITY = .0625

COMMAND ?
?



SF = 2.48 UNITS/INCH

LOAD CASE V
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = -2.33
Y ECC. = .00

R DIST = .09

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 2.82 UNITS/INCH

LOAD CASE V CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	30.685	IXP =	2.6	IYP =	2407.7
XBAR =	15.343	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	-4.760	FY =	0.000	FZ =	-43.430
MX =	-21.7	MY =	565.2	MZ =	2.4

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	-4.760	FY =	0.000	FZ =	-43.430
MX =	-21.7	MY =	565.2	MZ =	2.4

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

				2.059
	0.000	0.000	0.000	.770
A	30.685	0.000	0.000	.772
B	30.685	1.000	0.000	2.061
C	0.000	1.000	0.000	
D				

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 180.00

FACTOR OF SAFETY = 78.83

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

Sect (1)

LOAD CASE VI CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	11.130	FY =	0.000	FZ =	-45.980
MX =	-23.0	MY =	655.9	MZ =	-5.6

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	.875
B	30.685	0.000	0.000	0.000
C	30.685	1.000	0.000	0.000
D	0.000	1.000	0.000	.875

PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT

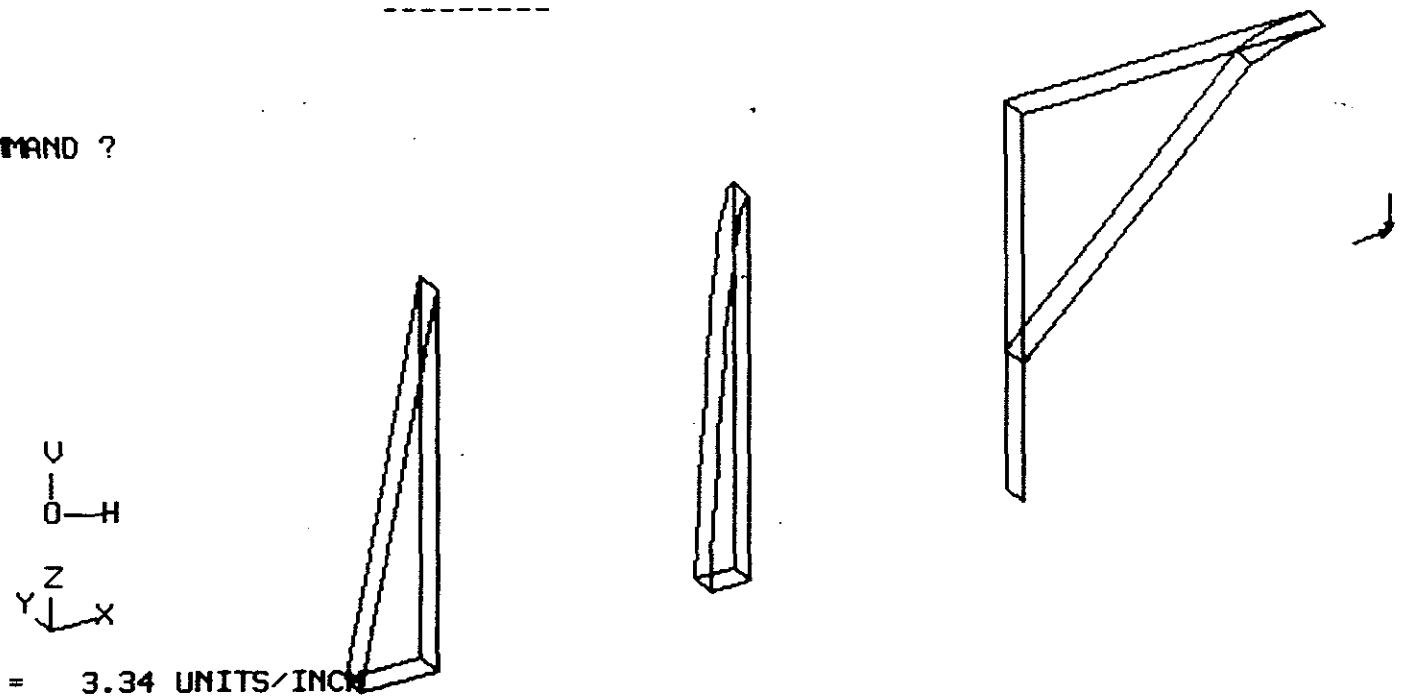
DENSITY = .0625

CASE ( )

COMMAND ?
? FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	11.13 -22.99	0.00 655.86	-45.98 -5.57

COMMAND ?
?



SF = 3.34 UNITS/INCH

LOAD CASE VI
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = .59
Y ECC. = 0.00

R DIST = .15

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 2.82 UNITS/INCH

LOAD CASE VI CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	30.685	IXP =	2.6	IYP =	2407.7
XBAR =	15.343	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	11.130	FY =	0.000	FZ =	-45.980
MX =	-23.0	MY =	655.9	MZ =	-5.6

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	13.425
MX =	6.7	MY =	-137.3	MZ =	0.0

--TOTAL--

FX =	11.130	FY =	0.000	FZ =	-32.555
MX =	-16.3	MY =	518.5	MZ =	-5.6

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	.939
B	30.685	0.000	0.000	1.182
C	30.685	1.000	0.000	1.182
D	0.000	1.000	0.000	.939

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FACTOR OF SAFETY = 33.22

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

CASE 4

XSECT (1)

elev upstream = 0.0

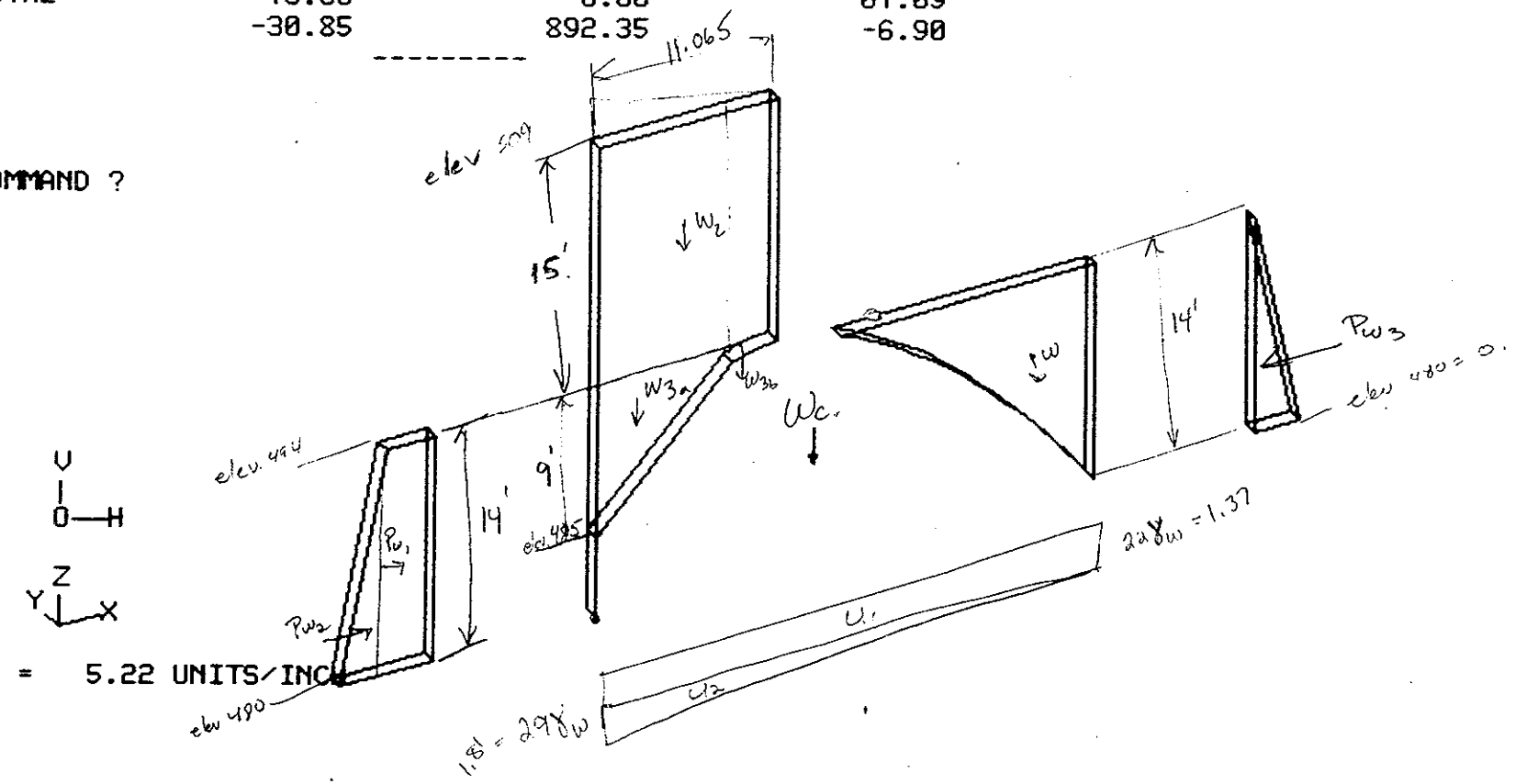
upst. water @ elev. 509 to compare w/ orig. calc's (instead of 512.

```
10  THOMASTON DAM STABILITY
20 20 26.56 11.52
30 0
40 0 0 0
50 0
60 0 0 0
70 .0625 .03 .1
80 14 0
90 0 0
100 29 22
110 OVERFLOW 1 .15 0
120 0 0
130 0 0 0 5 0
140 0 8.375 13.375 1
150 13.375 2.69 14 6.1 0 0 0 E
160 0 19.62 .01 0 1.776 14.115
170 0 .01 0
180 0 .01 0
190 0 0 .01 0
200 0 0
210 0 0 0 0
220 0 0 0 0
230 0 0
/
```

COMMAND ?
? FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	13.80 -30.85	0.00 892.35	-61.69 -6.90

COMMAND ?
?



SF = 5.22 UNITS/INCH

LOAD CASE IV
CATEGORY = 2

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

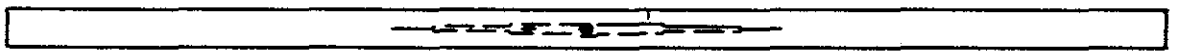
X ECC. = -1.55
Y ECC. = .00

R DIST = .12

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 2.82 UNITS/INCH



LOAD CASE IV CATEGORY = 2

FINAL BASE AREA PROPERTIES

AREA =	30.685	IXP =	2.6	IYP =	2407.7
XBAR =	15.343	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	13.800	FY =	0.000	FZ =	-61.690 - 43.43 = 18.260 water
MX =	-30.9	MY =	892.4	MZ =	-6.9

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	48.904 = 48.75
MX =	24.5	MY =	-716.0	MZ =	0.0

--TOTAL--

FX =	13.800	FY =	0.000	FZ =	-12.786
MX =	-6.4	MY =	176.4	MZ =	-6.9

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

4

A	0.000	0.000	0.000	.542
B	30.685	0.000	0.000	.290
C	30.685	1.000	0.000	.291
D	0.000	1.000	0.000	.544

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FACTOR OF SAFETY = 26.08

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

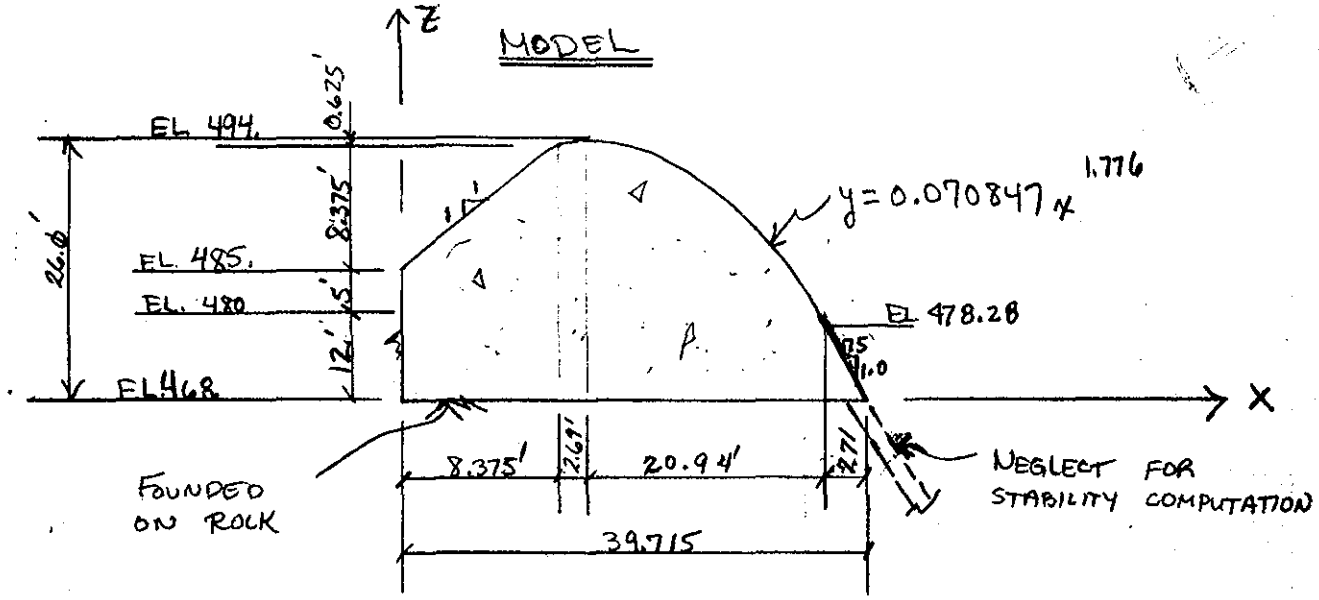
STABILITY ACHIEVED FOR THIS LOAD CASE

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: THOMASTON STABILITY
COMPUTATION: COMPUTER MODEL - XSECTION ② & INPUT
COMPUTED BY: RK CHECKED BY: DATE:

MODEL



COMPUTER INPUT - REF: COMPUTER AIDED STABILITY ANALYSIS OF CONCRETE HYDRAULIC STRUCTURES. - 'CDAMS'
SEE PG. FOR XSECTION DETAILS

* INPUT

```
10  THOMASTON DAM STABILITY
20  20.   26.56   11.52
30  Φ
40  Φ   Φ   Φ
50  Φ
60  Φ   Φ   Φ
70  Φ.Φ625   Φ.Φ3   Φ.1
80  26   Φ
90  Φ   Φ
100 44   34
110 OVERFLOW   1.Φ   0.15   Φ
120 Φ   Φ
130 Φ   Φ   Φ   17   Φ
140 Φ   8.375   25.375   1
150 25.375   2.69   26   6.1   Φ Φ Φ E
160 Φ   2Φ.94   1Φ.28   Φ   1.776   14.115
170 7.71   Φ.Φ1   Φ.75
180 Φ   Φ.Φ1   Φ
190 Φ   Φ   .Φ1   Φ
200 Φ   Φ
210 Φ   Φ   Φ   Φ
220 Φ   Φ   Φ   Φ
230 Φ   Φ
```

* NOTE: UNITS ARE

VARIABLES

TITLE
Allow. bearing Φ shear strength
elev. of upstream soil layer
γ_{DRY} γ_{BUOY} K
elev. of downstream soil layer
γ_{DRY} γ_{BUOY} K
γ_{WATER} wind pressure seismic coeff.
normal headwater elev. tailwater elev.
Induced surcharge headwater elev. tailwater elev
flood headwater elev. tailwater elev
Xsection type depth unit wt. No of cells
XDRAIN % effective
X_1 ELHEEL X102 EL10 SLP11
HEEL X104 XELBK USLP
EL12 X105 ELREST R11 XPUR11 CH. E
X106 X107 EL13 R12 XPUR12 C12
X108 EL14 SLP13
X109 EL15 R13
X110 X111 EL16 SLP14
ELTOE BSLP
ANCHOR LOAD XANCHOR YANCHOR ELANCHOR
MISC LOAD XMISC YMISC ELMISC
ICE LOAD THICKNESS

XSECT (2)

```
10 THOMASTON DAM STABILITY XSECT2
20 20 26.56 11.52
30 0
40 0 0 0
50 0
60 0 0 0
70 .0625 .03 .1
80 26 0
90 0 0
100 44 34
110 OVERFLOW 1 .15 0
120 0 0
130 0 0 0 17 0
140 0 8.375 25.375 1
150 25.375 2.69 26 6.1 0 0 0 E
160 0 20.94 10.28 0 1.776 14.115
170 7.71 .01 .75
180 0 .01 0
190 0 0 .01 0
200 0 0
210 0 0 0 0
220 0 0 0 0
230 0 0
/
```

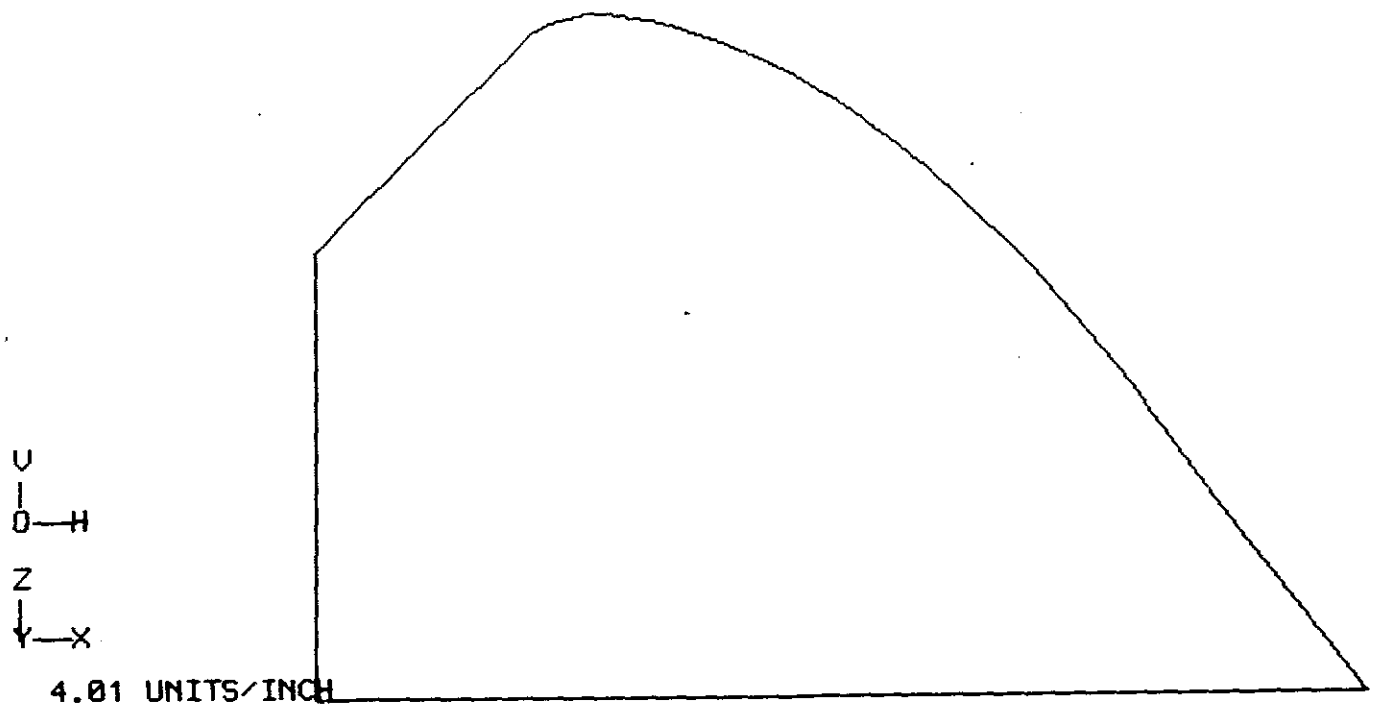
TYPE ANY GENERAL GEOMETRY COMMAND SUCH AS 'ISOMETRIC', 'PLOT', 'VOLUME', OR TYPE 'GO' TO GO ON TO GENERAL LOADS MODULE.

COMMAND ?
? VOLUME

NO.	NAME	VOLUME	WEIGHT	XCG	YCG	ZCG
	TOTAL	711.98	106.80	16.05	.50	10.51

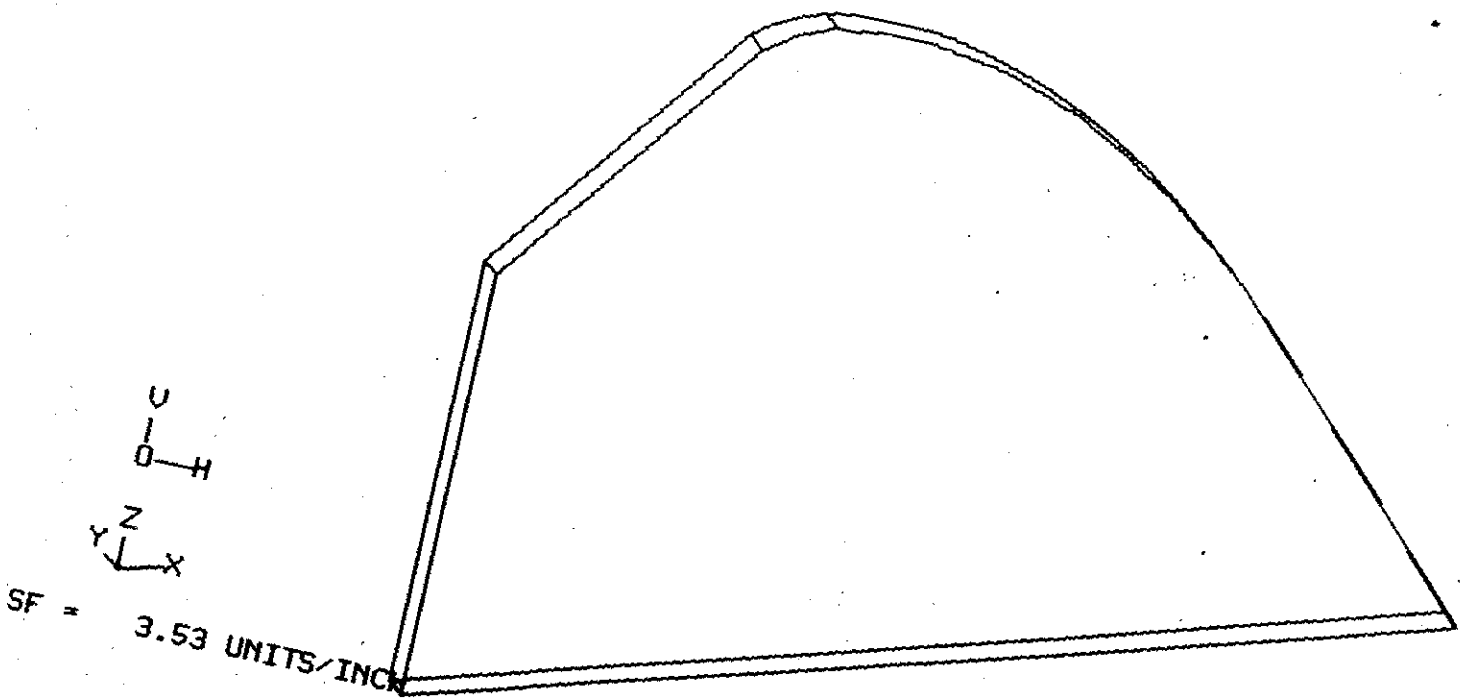
COMMAND ?
?

COMMAND ?
?



SF = 4.01 UNITS/INCH

? COMMAND ?



LOAD CASE I CATEGORY = 2

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	-.780	FY =	0.000	FZ =	-106.800
MX =	-53.4	MY =	1704.0	MZ =	.4

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	39.708	0.000	0.000	0.000
C	39.708	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 11.52 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE I
CATEGORY = 2

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = -3.90
Y ECC. = 0.00

R DIST = .07

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 3.65 UNITS/INCH

LOAD CASE I CATEGORY = 2

FINAL BASE AREA PROPERTIES

AREA =	39.708	IXP =	3.3	IYP =	5217.2
XBAR =	19.854	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000			--INPUT--	
FX =	-.780	FY =	0.000	FZ =	-106.800
MX =	-53.4	MY =	1704.0	MZ =	.4

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	-.780	FY =	0.000	FZ =	-106.800
MX =	-53.4	MY =	1704.0	MZ =	.4

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE
A	0.000	0.000	0.000	4.274
B	39.708	0.000	0.000	1.105
C	39.708	1.000	0.000	1.105
D	0.000	1.000	0.000	4.274

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 180.00

FACTOR OF SAFETY = 655.02

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

xset 2

LOAD CASE II CATEGORY = 1

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

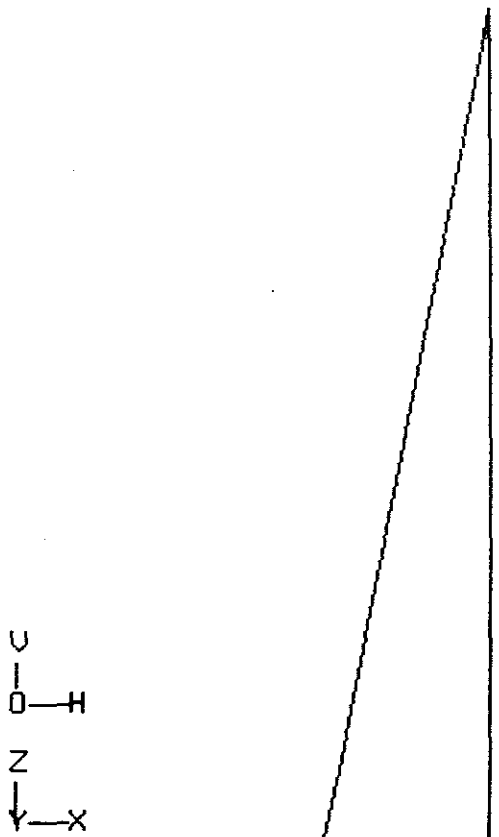
FX =	21.130	FY =	0.000	FZ =	-109.350
MX =	-54.7	MY =	1905.0	MZ =	-10.6

INPUT COORDINATES AND UPLIFT VALUES

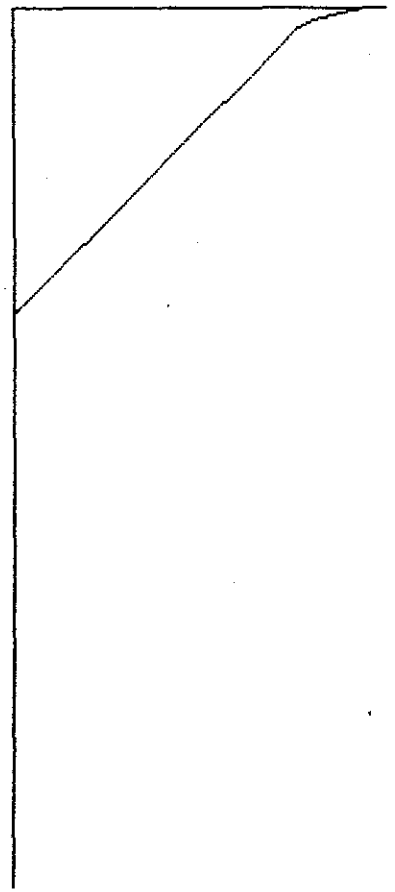
NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	1.625
B	39.708	0.000	0.000	0.000
C	39.708	1.000	0.000	0.000
D	0.000	1.000	0.000	1.625

PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT
		DENSITY =	.0625		

COMMAND ?



SF = 3.16 UNITS/INCH



LOAD CASE II
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = -.68
Y ECC. = .00

R DIST = .15

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 3.65 UNITS/INCH

LOAD CASE II CATEGORY = 1

FINAL BASE AREA PROPERTIES

AREA =	39.708	IXP =	3.3	IYP =	5217.2
XBAR =	19.854	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	21.130	FY =	0.000	FZ =	-109.350
MX =	-54.7	MY =	1905.0	MZ =	-10.6

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	32.262
MX =	16.1	MY =	-427.0	MZ =	0.0

--TOTAL--

FX =	21.130	FY =	0.000	FZ =	-77.088
MX =	-38.5	MY =	1478.0	MZ =	-10.6

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

INATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE
A	0.000	0.000	0.000	2.140
B	39.708	0.000	0.000	1.741
C	39.708	1.000	0.000	1.742
D	0.000	1.000	0.000	2.142

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FACTOR OF SAFETY = 23.48

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

xsect (2)

LOAD CASE IV CATEGORY = 2

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	37.360	FY =	0.000	FZ =	-131.850
MX =	-65.9	MY =	2610.9	MZ =	-18.7

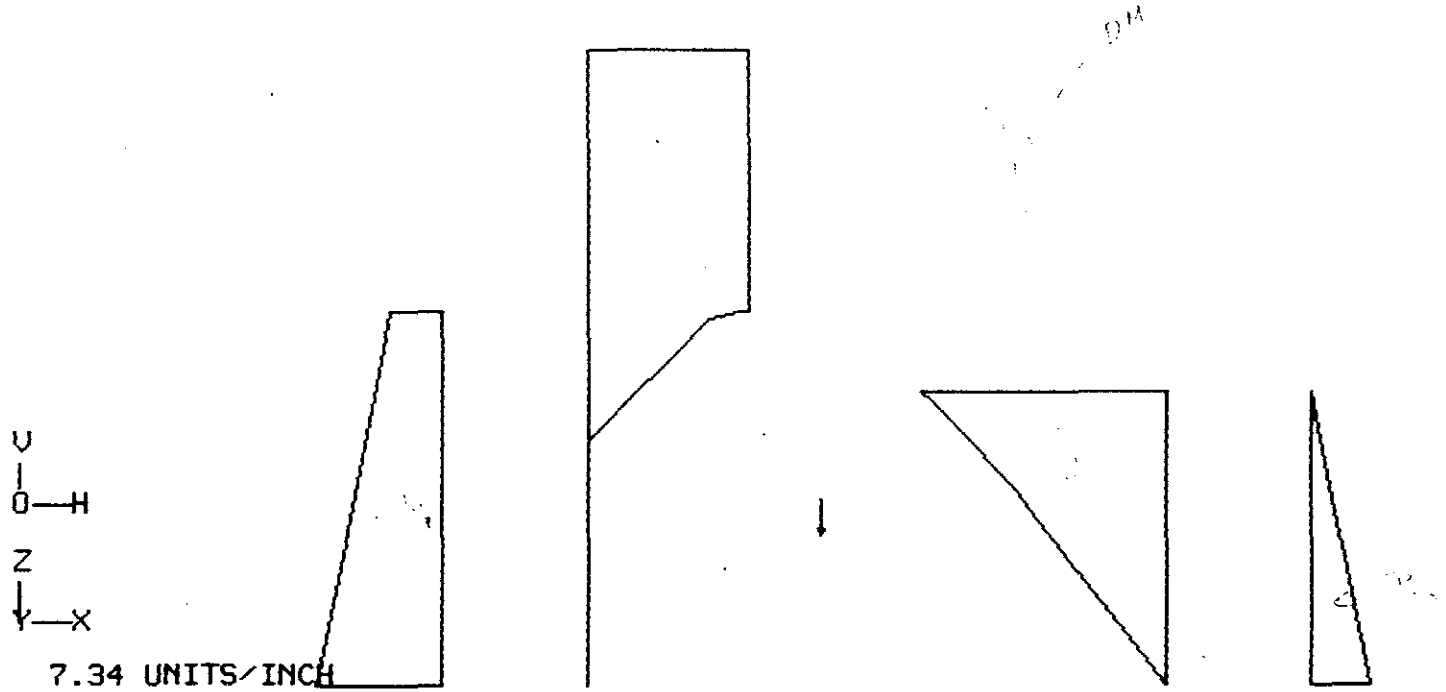
INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	2.750
B	39.708	0.000	0.000	2.125
C	39.708	1.000	0.000	2.125
D	0.000	1.000	0.000	2.750

PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT

DENSITY = .0625

COMMAND ?
?



SF = 7.34 UNITS/INCH

LOAD CASE IV
CATEGORY = 2

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = 2.15
Y ECC. = .00

R DIST = .11

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 3.65 UNITS/INCH

LOAD CASE IV CATEGORY = 2

FINAL BASE AREA PROPERTIES

AREA =	39.708	IXP =	3.3	IYP =	5217.2
XBAR =	19.854	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000				

--INPUT--

FX =	37.360	FY =	0.000	FZ =	-131.850
MX =	-65.9	MY =	2610.9	MZ =	-18.7

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	96.787
MX =	48.4	MY =	-1839.5	MZ =	0.0

--TOTAL--

FX =	37.360	FY =	0.000	FZ =	-35.063
MX =	-17.5	MY =	771.4	MZ =	-18.7

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE
A	0.000	0.000	0.000	.596
B	39.708	0.000	0.000	1.169
C	39.708	1.000	0.000	1.170
D	0.000	1.000	0.000	.597

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FACTOR OF SAFETY = 12.71

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

XSECT (2)

LOAD CASE V CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	-11.460	FY =	0.000	FZ =	-106.800
MX =	-53.4	MY =	1591.8	MZ =	5.7

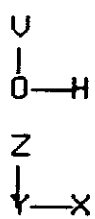
INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	39.708	0.000	0.000	0.000
C	39.708	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 11.52 SANGLE = DEFAULT

DENSITY = .0625

COMMAND ?
?



SF = 3.50 UNITS/INCH

LOAD CASE V
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = -4.95
Y ECC. = 0.00

R DIST = -.04

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 3.65 UNITS/INCH

LOAD CASE V CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	39.708	IXP =	3.3	IYP =	5217.2
XBAR =	19.854	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	-11.460	FY =	0.000	FZ =	-106.800
MX =	-53.4	MY =	1591.8	MZ =	5.7

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	-11.460	FY =	0.000	FZ =	-106.800
MX =	-53.4	MY =	1591.8	MZ =	5.7

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	4.701
B	39.708	0.000	0.000	.678
C	39.708	1.000	0.000	.678
D	0.000	1.000	0.000	4.701

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 180.00

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 180.00

FACTOR OF SAFETY = 44.58

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

Sect (2)

LOAD CASE VI CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

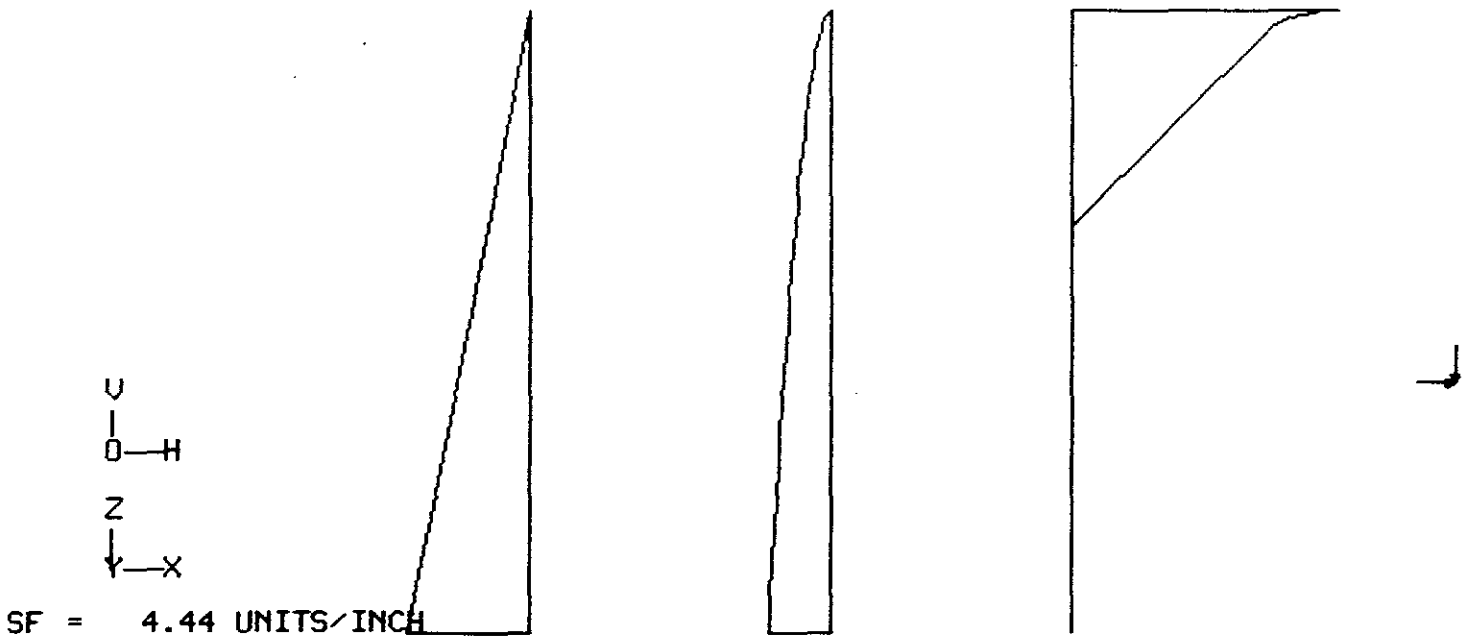
FX =	34.100	FY =	0.000	FZ =	-109.350
MX =	-54.7	MY =	2041.2	MZ =	-17.1

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	1.625
B	39.708	0.000	0.000	0.000
C	39.708	1.000	0.000	0.000
D	0.000	1.000	0.000	1.625

PHI =	26.60	SHRSTR =	11.52	SANGLE =	DEFAULT
		DENSITY =	.0625		

COMMAND ?



SF = 4.44 UNITS/INCH

LOAD CASE VI
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = 1.09
Y ECC. = .00

R DIST = .14

```
YG
|
ZG—XG

YL
|
└—XL
```

SF = 3.65 UNITS/INCH

LOAD CASE VI CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	39.708	IXP =	3.3	IYP =	5217.2
XBAR =	19.854	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	34.100	FY =	0.000	FZ =	-109.350
MX =	-54.7	MY =	2041.2	MZ =	-17.1

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	32.262
MX =	16.1	MY =	-427.0	MZ =	0.0

--TOTAL--

FX =	34.100	FY =	0.000	FZ =	-77.088
MX =	-38.5	MY =	1614.2	MZ =	-17.1

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	1.622
B	39.708	0.000	0.000	2.259
C	39.708	1.000	0.000	2.261
D	0.000	1.000	0.000	1.624

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FY = 0.000 FZ = -77.088
MX = -38.5 MY = 1614.2 MZ = -17.1

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE
A	0.000	0.000	0.000	1.622
B	39.708	0.000	0.000	2.259
C	39.708	1.000	0.000	2.261
D	0.000	1.000	0.000	1.624

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 11.52 SANGLE = 0.00

FACTOR OF SAFETY = 14.55

EFFECTIVE BASE = 100.0%

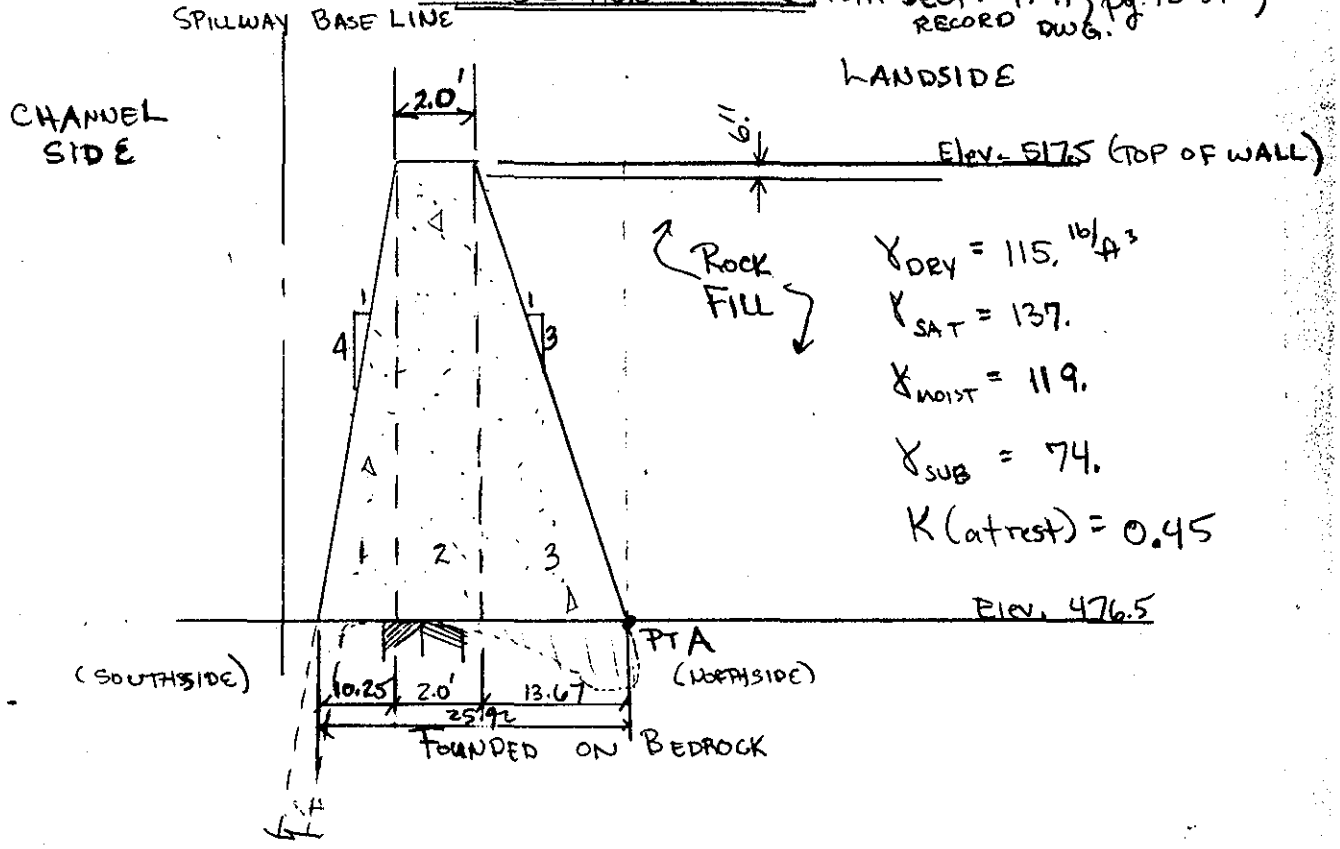
OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

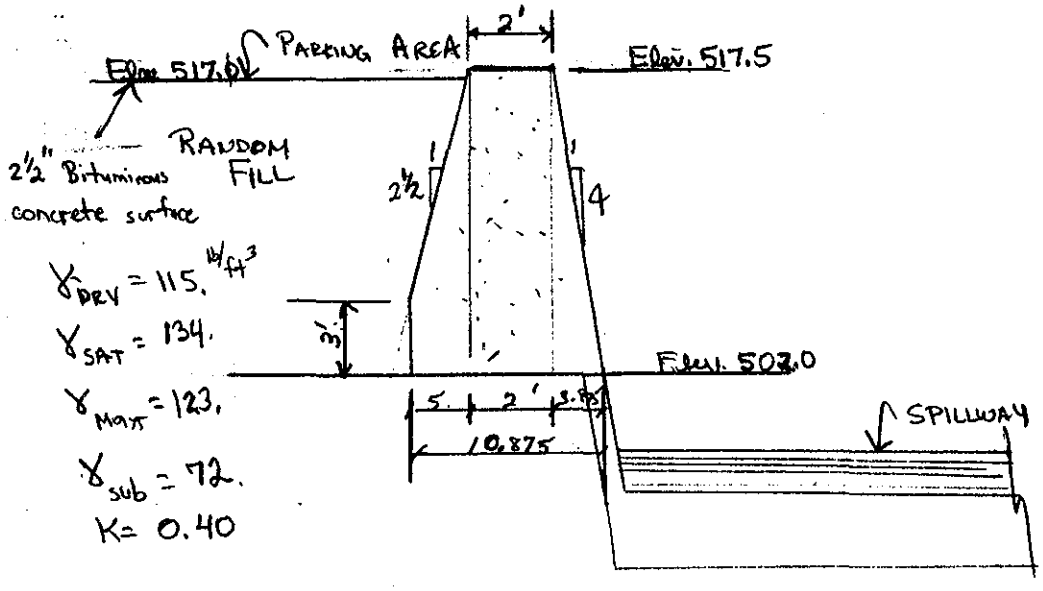
SPILLWAY TRAINING WALL, SEE SH 43 OF AS-BUILT RECORD DRAWING NO. HC-1-1230.
ANALYZE A 1.0 FT LENGTH OF WALL
CONSIDER AN IDEALIZED SECTION FOR ANALYSIS. NEGLECT CONCRETE LINER FOR STABILITY COMPS.

SECTION 1 (From sect. H-H, pg. 45 of RECORD DWG.)



$\gamma_{DRY} = 115.\ ^{lb}/_{ft^3}$
$\gamma_{SAT} = 137.$
$\gamma_{MOIST} = 119.$
$\gamma_{SUB} = 74.$
$K\ (at\ rest) = 0.45$

SECTION 2 (SECT J-J, pg 45 of CONTR. DWG)

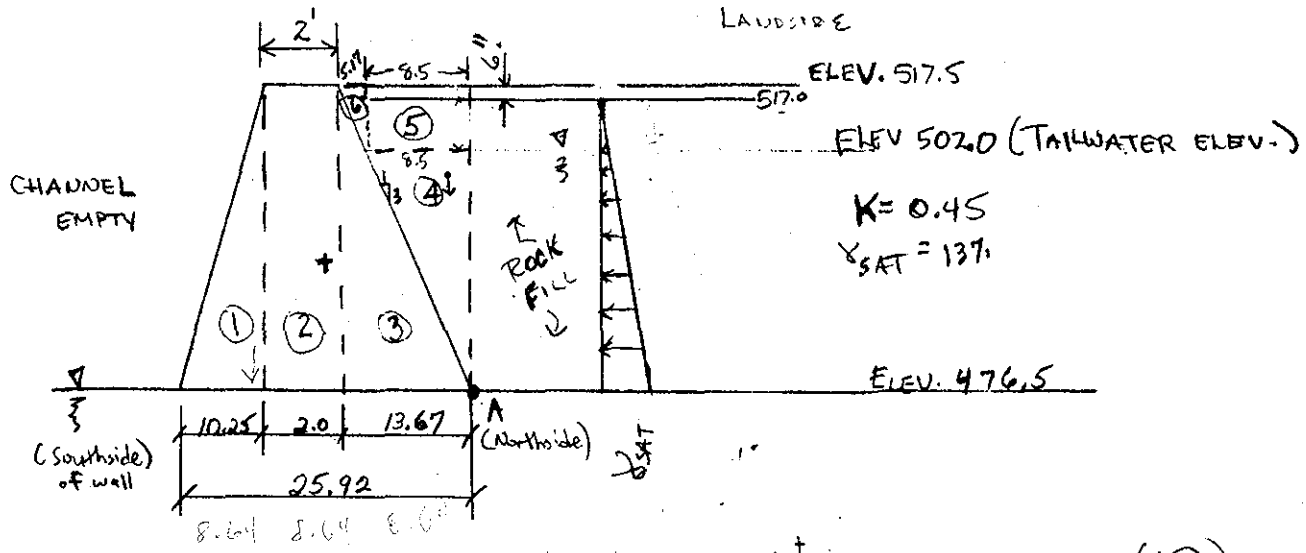


$\gamma_{DRY} = 115.\ ^{lb}/_{ft^3}$
$\gamma_{SAT} = 134.$
$\gamma_{MOIST} = 123.$
$\gamma_{sub} = 72.$
$K = 0.40$

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

SPILLWAY TRAINING WALL

CASE 1 - SECTION 1



ITEM	COMPUTATION	$\overset{+}{\leftarrow}$ K HORIZ. FORCE	$\overset{+}{\downarrow}$ K VERT. FORCE	FT. MOM. ARM.	$(\circlearrowleft_{+})$ K-FT MOM. ABOUT PT. A
1	$(\frac{1}{2} \times 10.25 \times 41) \times .15$	—	31.52	19.10	602.0
2	$(2 \times 41) \times .15$	—	12.30	14.67	180.4
3	$(\frac{1}{2} \times 13.67 \times 41) \times .15$	—	42.04	9.11	383.0
4	$(\frac{1}{2} \times 25.5 \times 8.5) \times .137$	—	14.85	2.83	42.0
5	$(8.5 \times 15) \times .115$	—	14.66	4.25	62.3
6	$(\frac{1}{2} \times 5.17 \times 15) \times .115$	—	4.46	10.22	45.6
Rock Fill	$-(\frac{1}{2} \times .115 \times 40.5^2 \times .45)$	42.44	—	13.5	572.94
		42.44	Σ = 119.83	—	Σ = 1888.24

Location of Resultant from Pt. A $= \Sigma M / \Sigma V = 1888.24 / 119.83 = 15.76$ (within Kern)

SPILLWAY TRAINING WALL

Case 1 - section 1

compute base pressure

$$f = P/A \pm \frac{Mc}{I}$$

$$f = \frac{119.83}{25.92(1)} \pm \frac{119.83(2.8)(12.96)}{(25.92)^3/12}$$

$$= 4.62 \pm 3.0$$

$$= 7.62^{ksf}, \quad 1.62^{ksf} \quad < 20^{ksf} \quad \underline{ok}$$

(southside), (northside)

F.S. SLIDING

$$= \frac{119.83(0.5) + 0.08(25.92)(1)(144)}{42.44}$$

$$\doteq 8.4 \quad > 2 \quad \underline{ok}$$

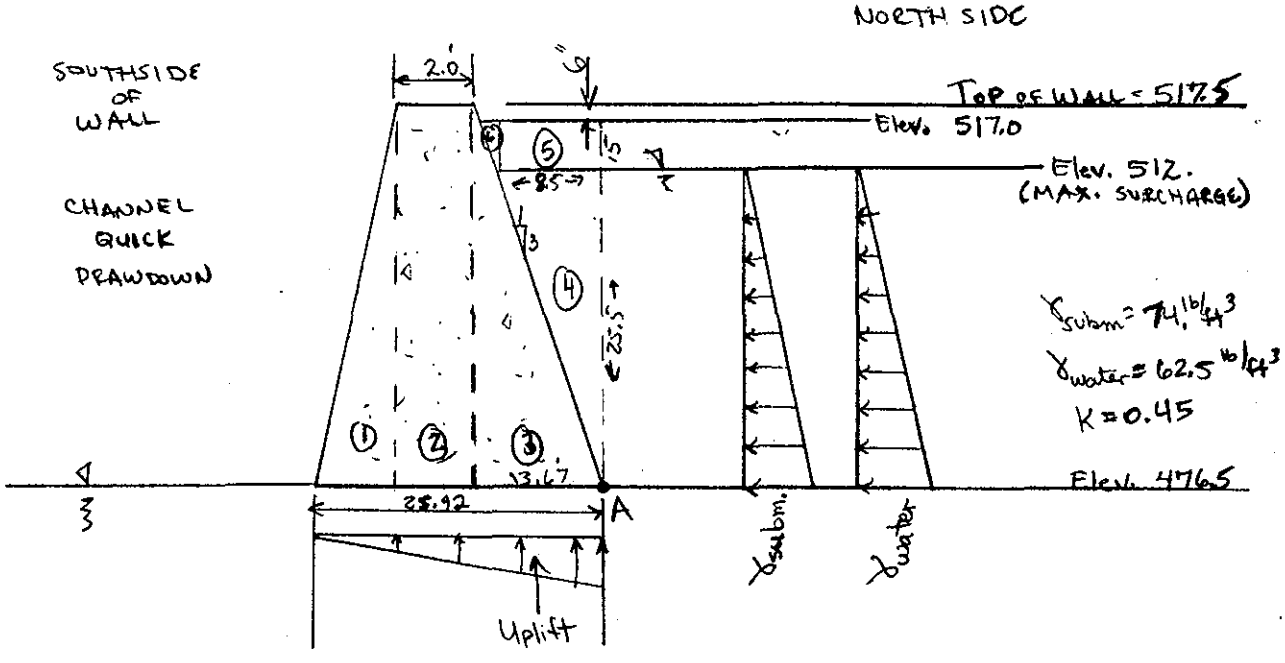
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

SPILLWAY TRAINING WALL

Case 2 - section 1



ITEM	COMPUTATION	K HORIZ. FORCE	K VERT. FORCE	FT MOM. ARM	K-FT MOM. ABOUT PT. A
1	see case 1 — sect 1	—	31.52	19.10	602.0
2	"	—	12.30	14.67	180.4
3	"	—	42.04	9.11	383.0
4, 5 + 6	$(\frac{1}{2} \times 13.5 \times 40.5)(74 + 62.5)/1000$	—	37.32	4.50	167.94
earth (North side)	$\frac{1}{2} \times .074 \times 35.5^2 \times 0.45$	20.98	—	11.83	248.19
water (North side)	$(\frac{1}{2} \times .0625 \times 35.5^2)$	39.38	—	11.83	465.87
Uplift	$-\frac{1}{2} \times .0625 \times 35.5 \times 25.92$	—	-28.76	8.64	-248.49
Σ		60.36	94.42	79.68	1798.91

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

SPILLWAY TRAINING WALL

case 2 - section 1

Location of resultant $= 1798.91 / 94.42 = 19.05$ (within base)

Length of base in bearing $\Rightarrow x = 3\left[\frac{L}{2} - e\right]$

where $e = \frac{25.92}{2} - 19.05 = 6.09$

$X = 3\left[6.09\right] = 18.27$

Base Pressure $\Rightarrow$

$$q_{max} = \frac{2\Sigma V}{xB} = \frac{2(94.42)}{18.27 \times 1} = 10.34^{ksf}$$ ok (on southside of wall)

F.S. SLIDING $\Rightarrow$

$$= \frac{94.42(0.5) + 0.08(25.92)(1)(144)}{60.36} = 5.73$$

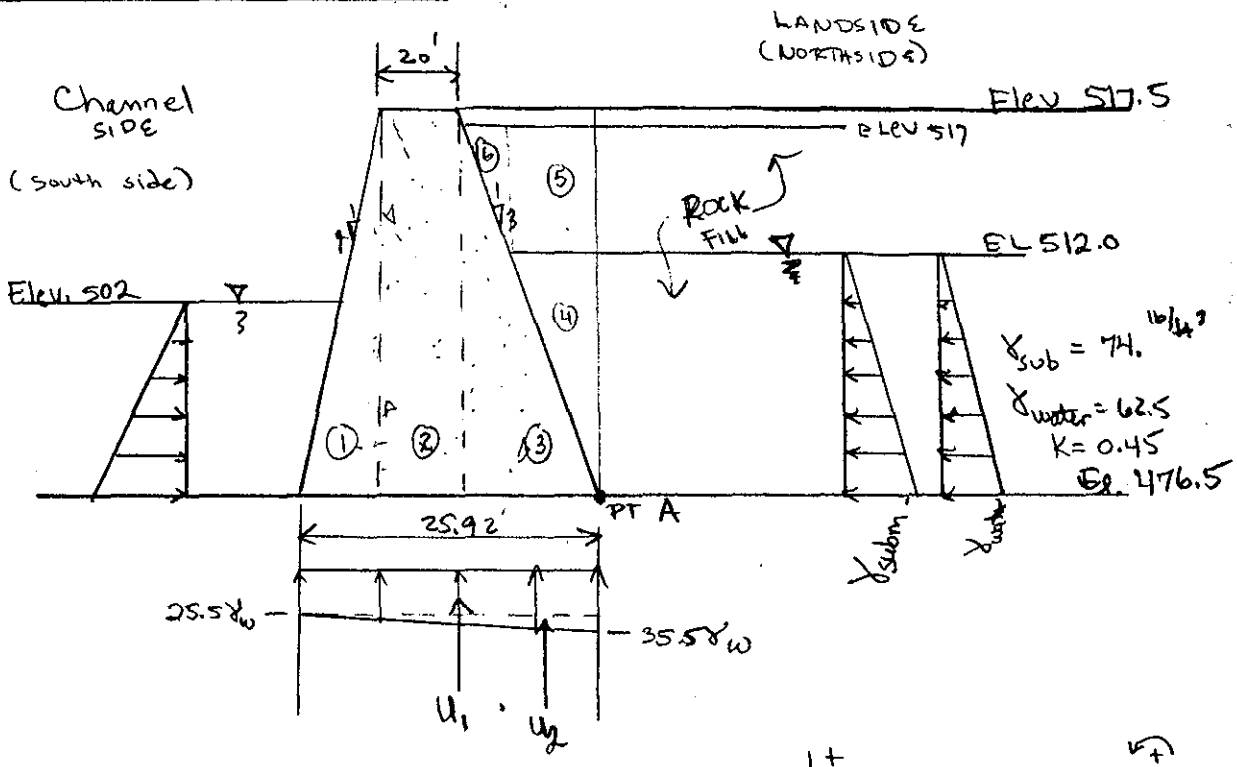
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

SPILLWAY TRAINING WALL

Case 3 - section 1



ITEM	COMPUTATION	← + K HORIZ FORCE	↓ + K VERT. FORCE	FT MOM. ARM.	↺ + K-FT MOM. ABT PT. A
①	see case 1 - sect 1	—	31.52	19.10	602.0
②	"	—	12.30	14.67	180.4
③	"	—	42.04	9.11	383.0
④, ⑤ & ⑥	see case 2 - sect 1	—	37.32	4.50	167.94
earth (south)	"	20.98	—	11.83	248.19
water (north)	"	39.38	—	11.83	465.87
water (south)	1/2 × .0625 × 25.5²	-20.32	—	8.5	-172.72
" U_1	- 25.5 × .0625 × 25.92	—	-41.31	12.96	-535.38
U_2	- 1/2 × 10.0 × .0625 × 25.92	—	-8.10	8.64	-69.98
Σ		40.04	73.77		1269.33

SPILLWAY TRAINING WALL

CASE 3 - SECTION 1

LOCATION OF RESULTANT $= \Sigma M / \Sigma V = 1269.33 / 73.77 = 17.21$

(within kern)

COMPUTE BASE PRESSURES $f = P/A \pm Mc/I$

$$f = \frac{73.77}{25.92(1)} \pm \frac{73.77(4.25)(12.96)}{(25.92)^3/12}$$

$$= 2.85 \pm 2.80$$

$$= \underset{\text{(southside)}}{5.65 \text{ ksf}}, \quad \underset{\text{(northside)}}{0.05 \text{ ksf}} \quad < 20 \text{ tsf} \quad \underline{\text{OK}}$$

F.S. SLIDING

$$= \frac{73.77(0.5) + 0.08(25.92)(1)(144)}{40.04} = 8.38 > 2$$

OK

SPILLWAY TRAINING WALL

Case IA. - Same as Case I with earthquake load added

Use Westergaard's eq. for additional water pressure due to earthquake. REF: EM1110-2-2200

$$P_e = \tfrac{2}{3} C_e \alpha y \sqrt{hy}$$

P_e = add. tot. water force due to earthquake

where $C_e = \dfrac{51}{\sqrt{1 - 0.72\left(\frac{h}{1000 t_e}\right)^2}}$

t_e assumed = 1.0 sec

$$= \frac{51}{\sqrt{1 - 0.72\left(\frac{41}{1000}\right)^2}} = 51.$$

α = ratio of earthquake accel, a to g = 0.10

h = hght of dam (or wall) = 41.'

y = depth of water

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

SPILLWAY TRAINING WALL

CASE IA.- Section ① - Same as Case I with earthquake load added.

1) Compute Inertia Force of backfill bet. monolith and a vertical plane through the toe.

Horiz. $= \frac{1}{2}(13.5)(40.5)(0.115)(.100) = 3.14$

MOM ARM $= \frac{2}{3}(40.5) = 27$

MOM $= 84.78^{1-k}$

From Case 1 - section 1:

Item	Horiz. Force	Vert Force	Mom Arm	Mom Abt Pt A
Σ ⇒ ① - ⑥, Rockfill	42.44 ←	119.83	—	1888.24^{1-k}
Earthquake	3.14^k ←	—	27	84.78^{1-k}
Σ'	45.58	119.83		1973.02^{1-k}

Location of Resultant from Pt. A $= 1973.02 / 119.83 = 16.47'$ (within kern)

$\therefore e = 3.51$

Compute Base Pressures $f = P/A \pm \frac{Mc}{I}$

$$= \frac{119.83}{25.92(1)} \pm \frac{119.83(3.51)(12.96)}{(25.92)^3/12}$$

$$= 4.62 \pm 3.76 = 8.38^{kaf} \text{ (south)}, \; 0.86^{kaf} \text{ (north)}$$

F.S. SLIDING $= \frac{119.83(0.5) + (0.08)(25.92)(1)(144)}{45.58} = 7.9 > 2$ OK

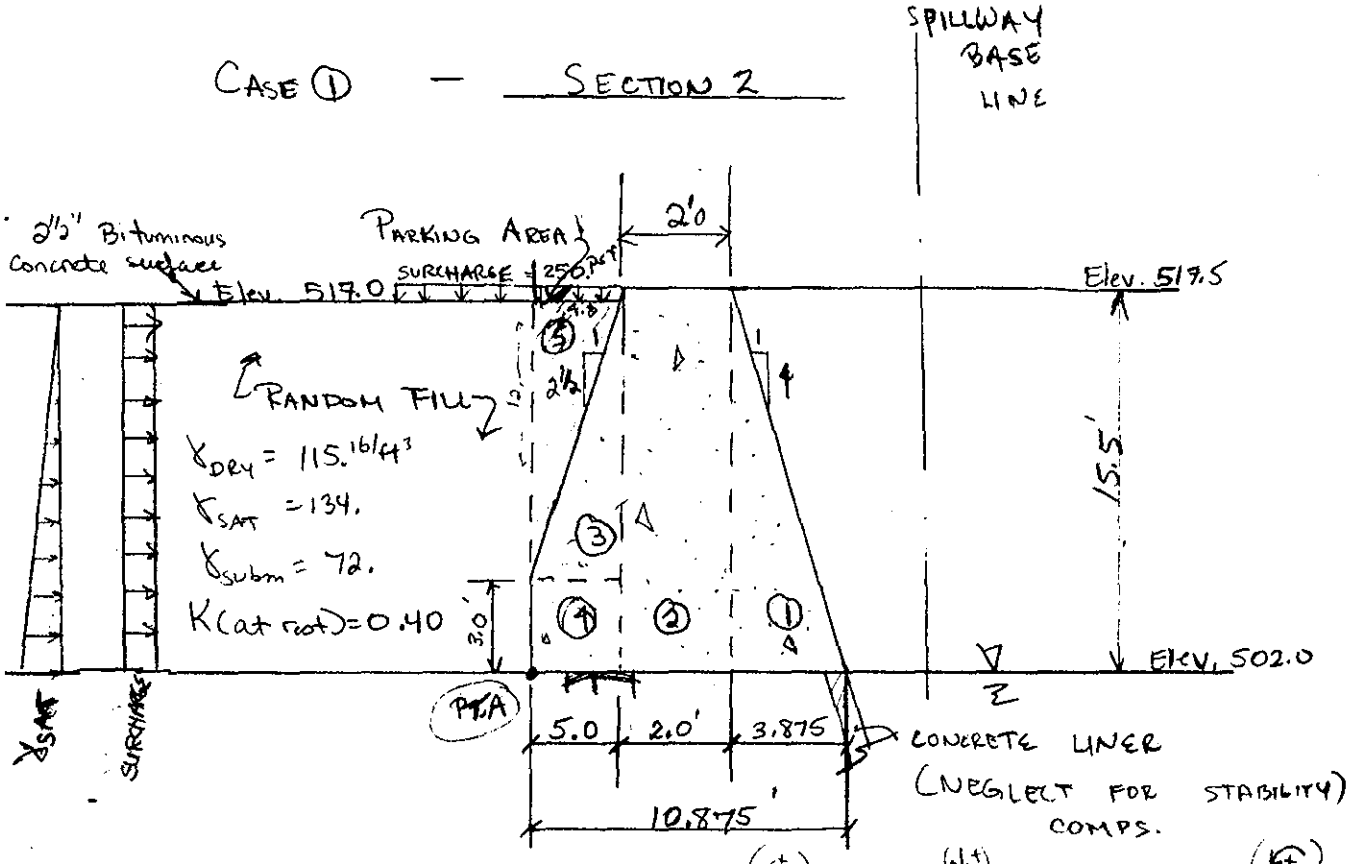
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

SPILLWAY TRAINING WALL; see SH. 45 OF AS-BUILT RECORD DRAWING NO. HC-1-1230; SECT J-J, sect. (2).
ANALYZE A 1.0 FT LENGTH OF WALL

CASE (1) — SECTION 2



ITEM	COMPUTATION	HORIZ FORCE (←) K	VERT. FORCE (↓+) K	MOM. ARM FT.	MOM. ABOUT PT. A (↺+) K-FT
(1)	(½ × 3.875 × 15.5) × .150 kip/ft³	—	4.50	8.29	37.31
(2)	2 × 15.5 × .150	—	4.65	6.00	27.90
(3)	½ × 5 × 12 × .150	—	4.50	3.33	14.99
(4)	5 × 3 × .150	—	2.25	2.50	5.63
(5)	½ × 4.8 × 12 × .134	—	3.86	1.60	6.20
earth	½ × .134 × 15² × 0.40	6.03	—	5.0	30.15
Surcharge	0.250 × 15.0' × 0.40	1.50	—	7.5	11.25
Σ		7.53	Σ = 19.76		133.43

SPILLWAY TRAINING WALL

case ① – section ② (cont.)

Location of Resultant from Pt. A

$$= \Sigma M / \Sigma V = 133.43 / 19.76 = 6.75 \text{ (within kern)}$$

BASE PRESSURE

$$f = P/A \pm \frac{Mc}{I}$$

$$f = \frac{19.76}{10.875} \pm \frac{19.76(1.3125)(5.4375)}{(10.875)^3/12}$$

$$f = 1.82 \pm 1.32$$

$$= 3.14^{ksf}, \quad 0.5^{ksf} \quad < 20^{tsf} \quad \text{OK}$$

F.S. SLIDING

$$= \frac{19.76(0.5) + 0.08(10.875)(1)(144)}{7.53}$$

$$= 18.0 \quad \text{OK}$$

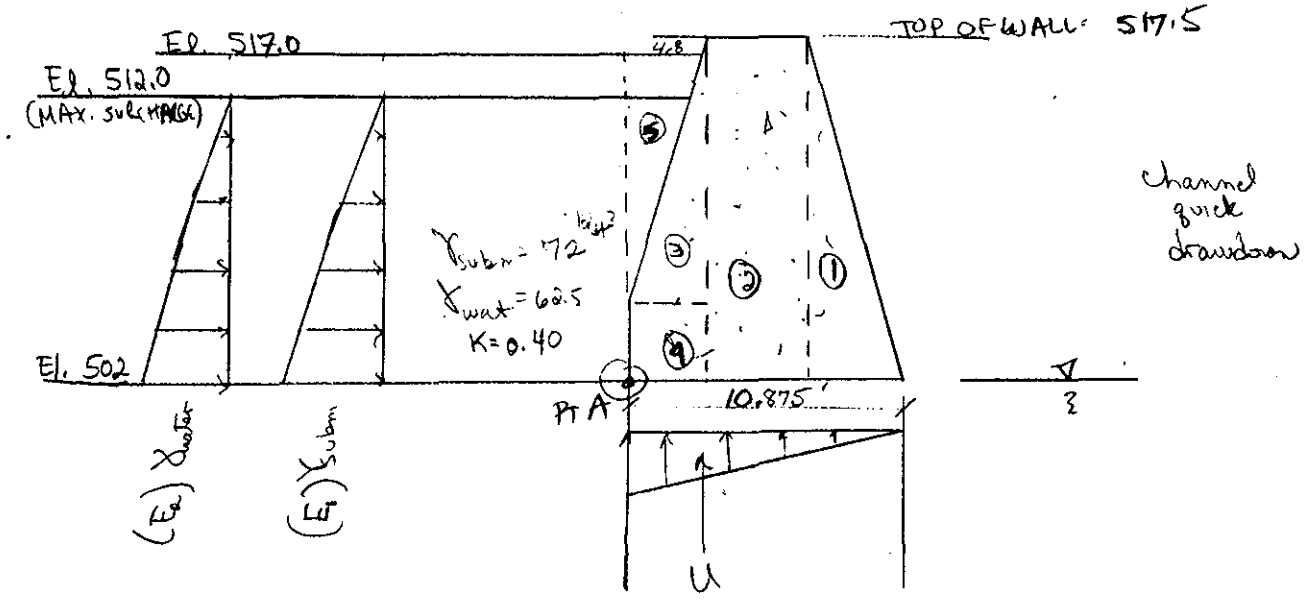
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

SPILLWAY . TRAINING . WALL

CASE 2 - SECTION 2



ITEM	COMPUTATION	HORIZ. FORCE	VERT. FORCE	MOM ARM	MOM ABT PT. A
1	same as case 1-sect 2	—	4.50	8.29	37.31
2	"	—	4.65	6.00	27.90
3	"	—	4.50	3.33	14.99
4	"	—	2.25	2.50	5.63
5	1/2 × 4.8 × 12 × (.072 + .0625)	—	3.87	1.60	6.20
E_1	1/2 × .072 × 10² × 0.40	1.44	—	3.33	4.80
E_2	1/2 × .0625 × 10²	3.13	—	3.33	10.41
U	− 1/2 × 10 × .0625 × 10.875	—	−3.40	3.625	−12.33
Σ		4.57	16.37		94.91

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

SPILLWAY TRAINING WALL

case 2 - section 2 (cont.)

LOCATION OF RESULTANT FROM PT. A $= \Sigma M / \Sigma V = 94.91 / 16.37 = 5.80$

(within Kern)

BASE PRESSURE

$$f = P/A \pm \frac{Mc}{I}$$

$$f = \frac{16.37}{10.875} \pm \frac{16.37(0.36)(5.4375)}{(10.875)^3/12}$$

$$= 1.51 \pm 0.30$$

$$= 1.81^{ksf}, \quad 1.21^{ksf} \quad < 20^{tsf} \quad \text{o/c}$$

F.S. SLIDING

$$= \frac{16.37(0.5) + 0.08(10.875)(1)(144)}{4.57}$$

$$= 29.2$$

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

SPILLWAY TRAINING WALL

CASE (3) - section (2)

Case (3) results will be the same as case (2) since the bottom elev. of the wall = drawdown elevation = water in channel to design flood elevation = 502.ft.

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

SPILLWAY TRAINING WALL

CASE IA - section ② - Same as CASE I w/ earthquake

1) Compute Inertia Force of backfill bet. monolith and a vertical plane through toe.

Horiz Force = $\frac{1}{2}(12)(4.8)(.115)(.100) = 0.33$

Mom. Arm = 11.0
Mom = $11 \times 0.33 = 3.64$

FROM CASE 1 - Section 2:

Item	← + K Horiz. Force	↓ + Vert. Force	Mom. Arm	↺ Mom. ABT Pt. A
Σ = ① → ⑤, earth, surcharge	7.53	19.76		133.43
earthquake	0.33	—	11.0	3.64
Σ' =	7.86	19.76	—	137.07

Location of Resultant from Pt. A = 137.07/19.76 = 6.94 (within Kern)

∴ e = 1.50

Compute Base Pressures = $f = P/A \pm \frac{Mc}{I}$

$= \frac{19.76}{(10.875)(1)} \pm \frac{19.76(1.50)(5.4375)}{(10.875)^3/12}$

$= 1.82 \pm 1.50 = 3.32^{ksf}_{(S)}, \; 0.32^{ksf}_{(N)}$

F.S. SLIDING

$= \frac{19.76(0.5) + 0.08(10.875)(1)(144)}{7.86} = 17.2$. OK

SUBJECT

COMPUTATION

COMPUTED BY CHECKED BY DATE

SPILLWAY TRAINING WALL

LOCATION OF CENTROID OF WALL:

	Area	$\bar{x}$	$\bar{y}$	$\bar{x}A$	$\bar{y}A$
1	210.125	19.10	13.67	4013.4	2872.4
2	82.0	14.67	20.50	1202.9	1681.0
3	280.235	9.11	13.67	2552.9	3830.8
	572.36			7769.2	8384.2

$$\bar{X}_{CG} = 7769.2 / 572.36 = 13.57 \text{ (from Pt. A)}$$

$$\bar{Y}_{CG} = 8384.2 / 572.36 = 14.65 \text{ (from pt. A)}$$

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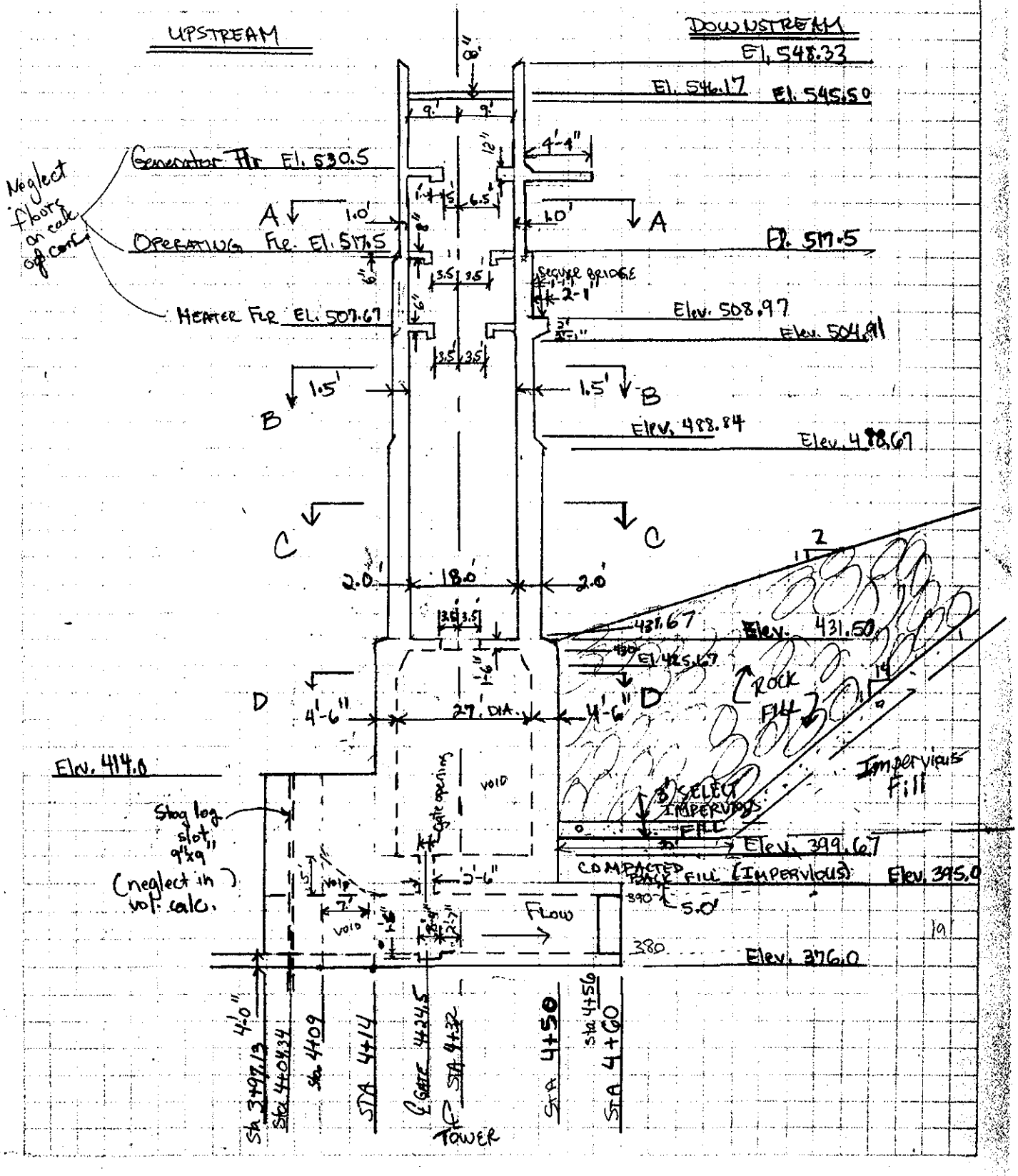
SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

GATE TOWER ; see SH 30 + 38 OF RECORD DRAWING NO. HC-1-1217.



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NEW ENGLAND DIVISION
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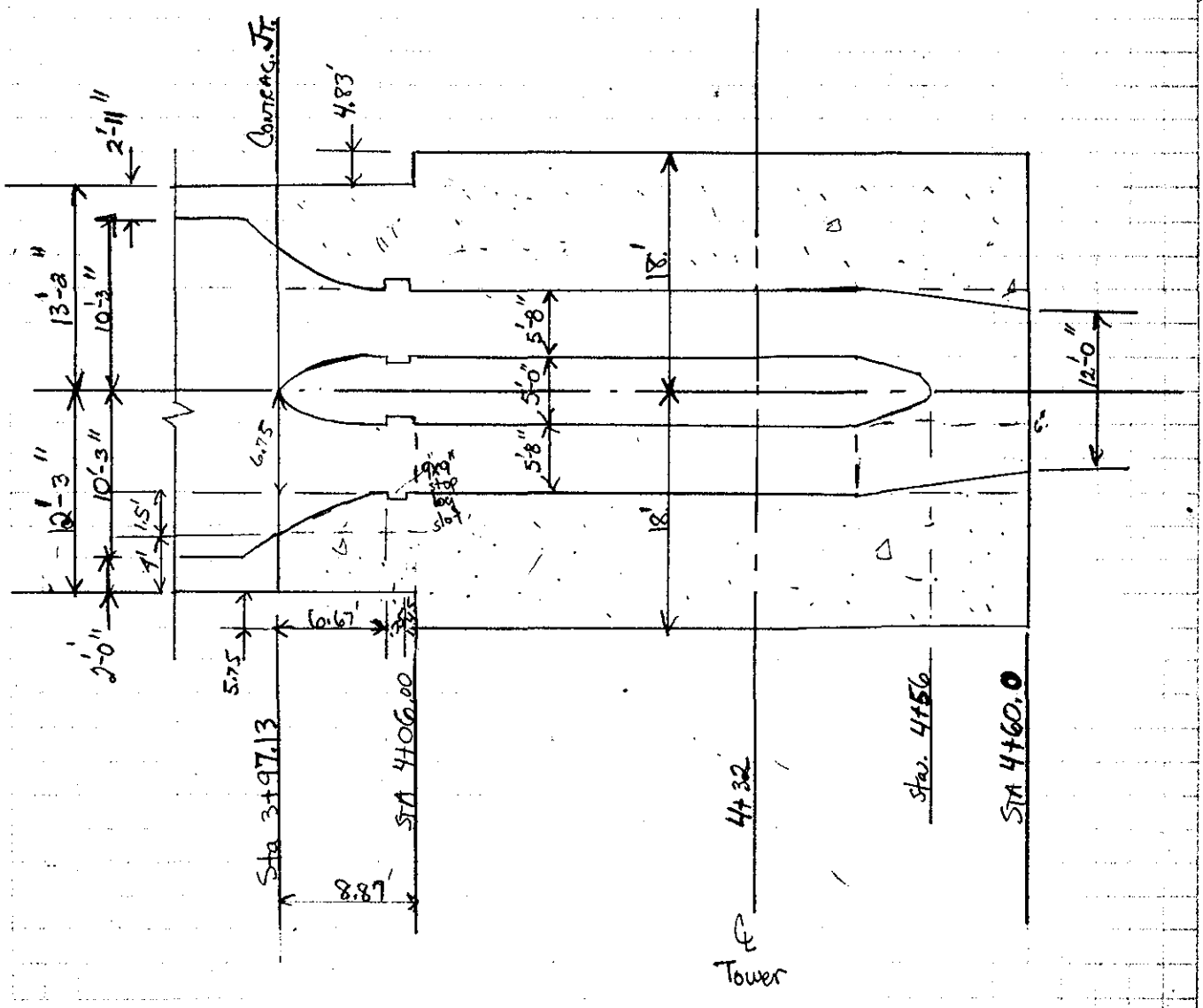
SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

GATE TOWER - SECTION @ ELEV. 380.0



SECTION AT ELEV. 380.0

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NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

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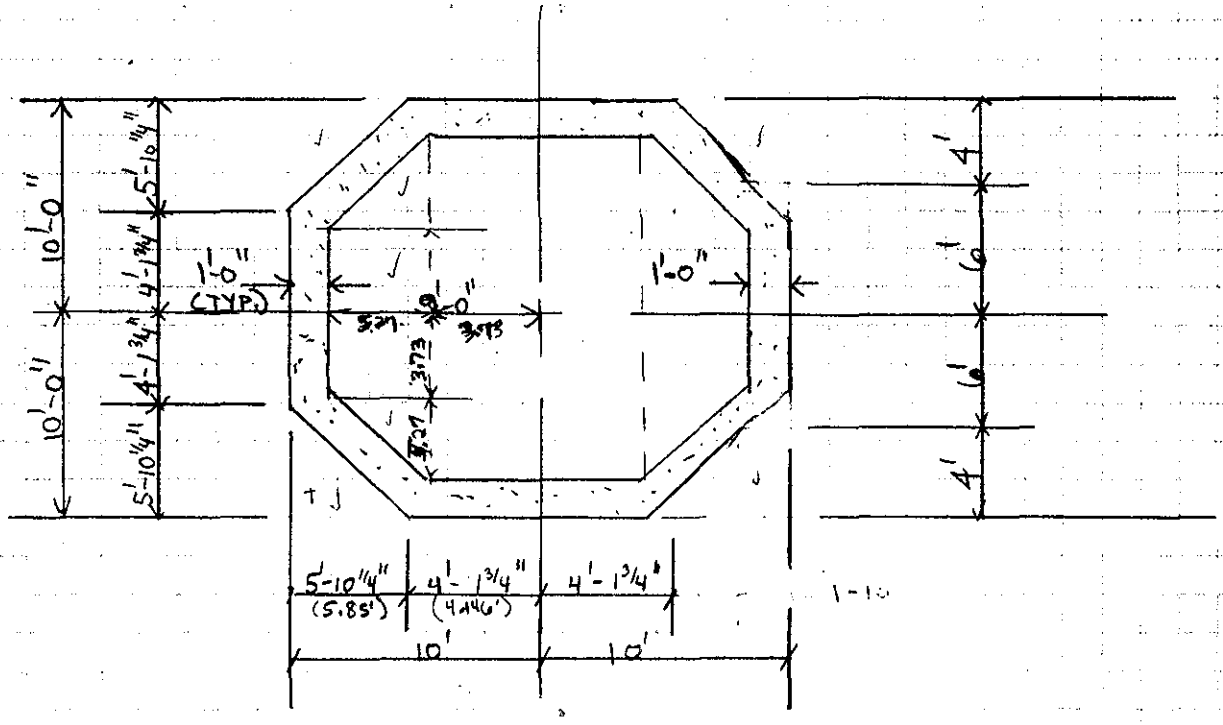
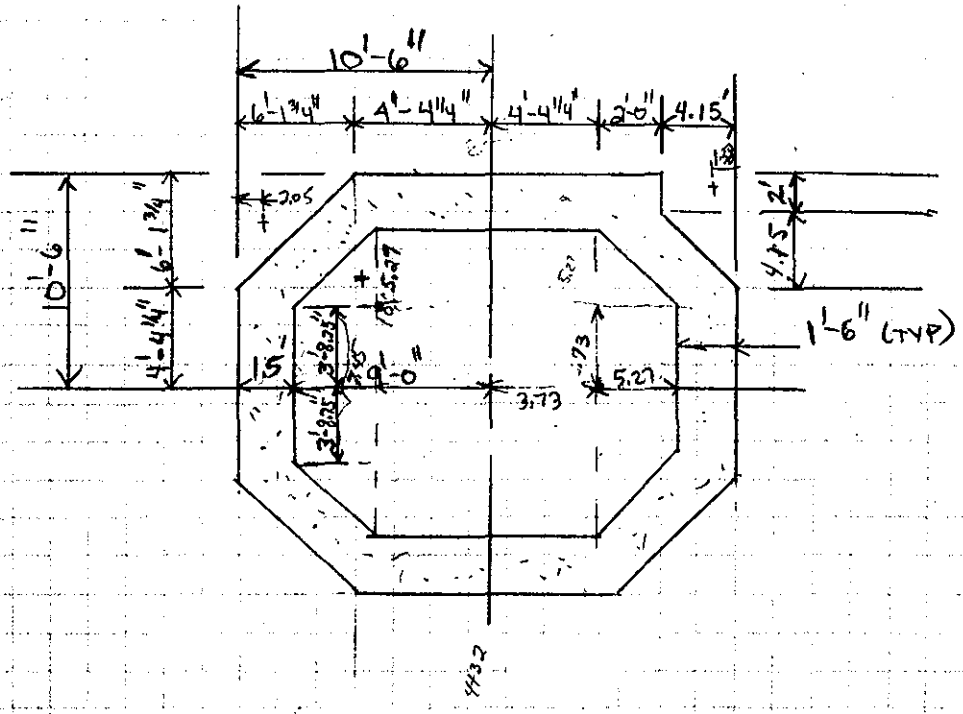
SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

GATE TOWER



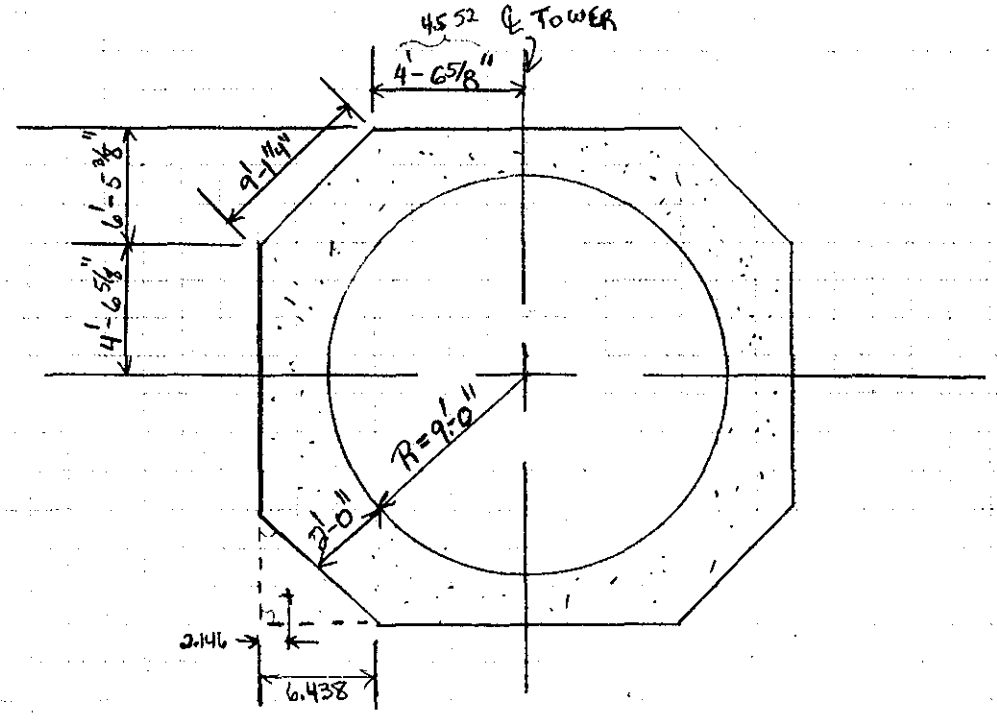
SECTION A-A



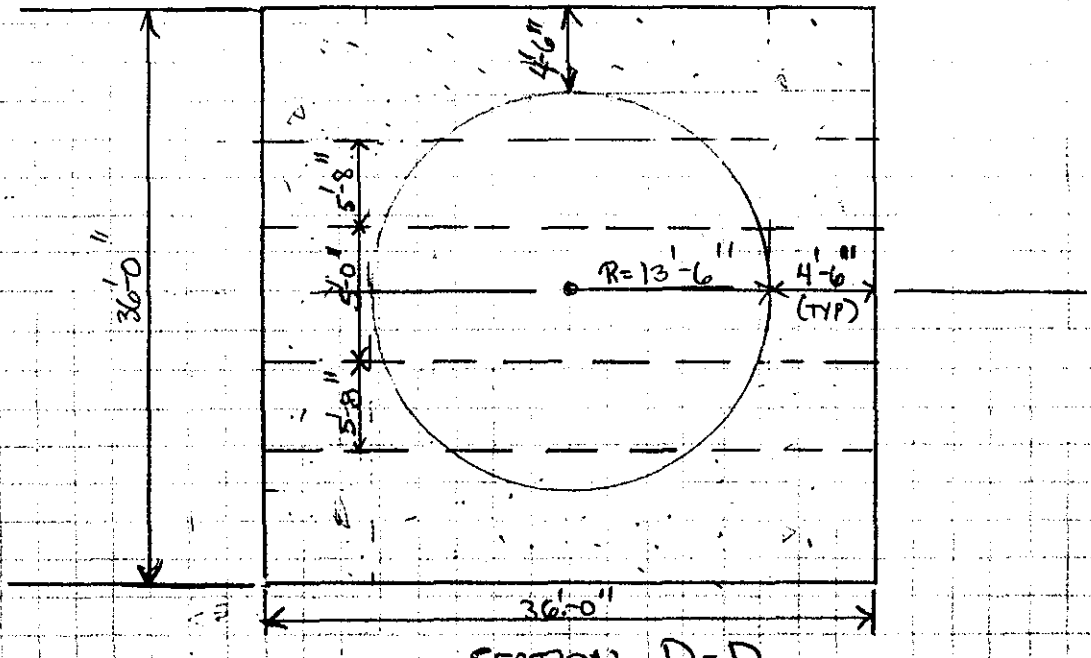
SECTION B-B

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

GATE TOWER



SECTION C-C



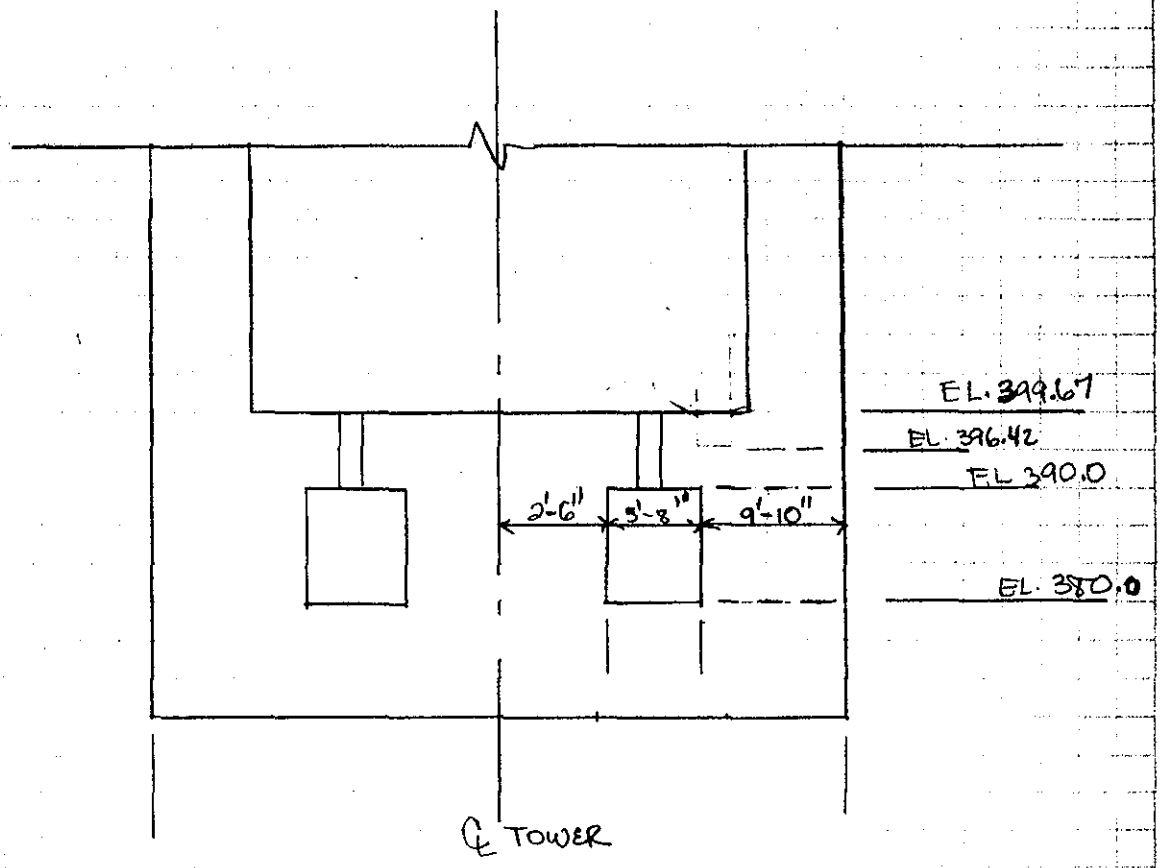
SECTION D-D

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

GATE TOWER - DETAILS OF GATE OPENINGS



LKG DOWNSTREAM

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

Gate Tower - Compute weight and C.G. of tower

Item	Volume (ft³)	$\bar{x}$ (ft)	$\bar{y}$ (ft)	$\bar{x}V$	$\bar{y}V$
Base	(460 - 406)(36)(4) = 7776	35.87	2.0	278,925.1	15,552.
"	½(406-397.13)(25.42)(4) = 450.95	4.435	2.0	2000.0	901.9
Base gate blockout	8.33(8)(1.5)(2) = 199.9	27.37	3.25	5471.8	649.7
El. 380 - 390	(460 - 397.13)(36)(10) = 22,633.2	31.435	9.0	711,474.6	203,698.8
"	- 5.75(8.87)(10) = - 510.0	4.435	9.0	- 2262.0	- 4590.2
	- 4.83(8.87)(10) = - 428.4	4.435	9.0	- 1900.0	- 3855.8
conduit	- 2(5.67)(460 - 397.13)10 = - 7129.5	31.435	9.0	-224,114.5	- 64,165.5
"	- 2(½)(6.67)(1.5)(10) = -100	2.22	9.0	-222.1	- 900.0
El. 390 - 395	(62.87)(36)(5) = + 11,316.6	31.435	16.5	355,737.2	186,723.9
gate opening	-2(2.5)(8)(5) = - 200	27.37	16.5	-5474.0	- 3300.0
	-8.87(5.75)(5) = - 255.0	4.435	16.5	- 1130.9	- 4207.7
	-8.87(4.83)(5) = - 214.2	4.435	16.5	-950.0	- 3534.5
void ↘	-½(5)(7)36 = - 630.	14.2	16.5	-8946.0	- 10,395.0
	-2(8.87)(406 - 397.13)(5) = - 786.8	4.435	16.5	-3489.3	- 12,981.7
	-2(½)(6.67)(1.5)(5) = - 50.0	2.22	16.5	- 111.1	- 825.4
El. 395 - 414	(450 - 397.13)(36)(19) = 36,163.0	26.435	28.5	955,971.0	1,030,647.8
	-π(13.5)²(414 - 399.67) = - 8204.7	34.87	30.84	- 286,098.5	- 253,033.5
	-2(2.5)(8)(4.67) = - 186.8	27.37	21.34	- 5112.8	- 3986.3
	-8.87(5.75)(19) = - 969.0	4.435	28.5	- 4297.7	- 27,617.9
	-8.87(4.83)(19) = - 814.0	4.435	28.5	- 3610.1	- 23,199.0
	-2(8.87)(5)(19) = - 1685.3	4.435	28.5	- 7474.3	- 48,031.1
	-2(½)(6.67)(1.5)(19) = - 190.0	2.22	28.5	- 422.0	- 5417.9
El. 414 - 431.67	(431.67 - 414)(36)² 22,900.3	34.87	46.84	798,534.2	1,072,651.0
	-π(13.5)²(16.17) = - 9258.2	34.87	46.10	- 322,834.1	- 426,803.9
	-7(1.5)5 = - 52.5	34.87	54.92	- 1830.7	- 2883.3
El. 431.67 - 488.67	(57)(22)(22) = 27,588.	34.87	84.17	961,993.6	2,322,082.0
	-π(9)²(57) = - 14504.7	34.87	84.17	- 505,780.1	- 1,220,863.4
	-2(½)(6.438)²(57) = - 2362.5	26.02	84.17	- 61,473.0	- 198,853.9
	-2(½)(6.438)²(57) = - 2362.5	43.724	84.17	- 103,299.1	- 198,853.9
El. 488.67 - 517.5	(28.83)(21)(21) = 12,714.	34.87	127.09	443,338.2	1,615,826.1
	-½(6.145)²(28.83)×2 = - 1088.7	26.42	127.09	- 28,762.1	- 138,356.6
	-½(4.15)²(28.83) = - 248.3	43.99	127.09	- 10,921.1	- 31,551.7
	-(4.15)(2)(28.83) = - 239.3	43.30	127.09	- 10,361.2	- 30,411.2
	-(8.71)(18)(28.83) = - 4520.0	34.87	127.09	- 157,612.4	- 574,446.8
	-½(5.27)²(28.83)2 = - 800.7	29.38	127.09	- 23,524.6	- 101,761.0
	-7.45(5.27)(28.83) = - 1131.9	28.51	127.09	- 32,270.7	- 143,854.3
	-½(5.27)²(28.83)2 = - 800.7	40.36	127.09	- 32,316.3	- 101,761.0
	-7.45(5.27)(28.83) = - 1131.9	41.24	127.09	- 46,679.7	- 143,854.3
	-½(6.145)²(28.83) = - 544	43.32	127.09	- 23,580.0	- 69,178.3

2208.3

$\Sigma' = 80,342.2$ $\Sigma' = 2,596,585.1$ $\Sigma = 2,595,258.1$

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

GATE TOWER - Compute weight and C.G. OF TOWER (CONT.)

ITEM	VOLUME (FT³)	$\bar{x}$ (ft)	$\bar{y}$ (ft)	$\bar{x}V$	$\bar{y}V$
El. 517.5 = 548.33	30.83(22)(20) = + 12332.	34.87	156.915	430,016.8	1,935,075.8
	− ½(5.85)²(30.83)2 = −1055.1	28.77	156.915	− 30,354.6	− 165,557.8
	− ½(5.85)²(30.83)2 = −1055.1	42.92	156.915	− 45,284.0	− 165,557.8
	− ½(5.27)²(30.83)2 = −856.2	29.38	156.915	− 25,156.3	− 134,356.7
	− 5.27(7.45)(30.83) = −1210.4	28.51	156.915	− 34,509.4	− 189,934.9
	− 7.45(18)(30.83) = −4134.3	34.87	156.915	− 144,163.2	− 648,734.2
	− ½(5.27)²(30.83)2 = −856.2	40.36	156.915	− 34,557.8	− 134,356.7
	− 5.27(7.45)(30.83) = −1210.4	41.24	156.915	− 49,918.2	− 189,934.9
Roof	+ (8/12)(½)(5.27)² 2 = 18.5	29.38	169.84	+ 543.0	+ 3144.6
	+ 8/12 (5.27)(7.45) = 26.2	28.51	169.84	+ 746.2	+ 4445.4
	+ 8/12 (8.71)(18) = 104.5	34.87	169.84	+ 3644.6	+ 17,751.7
	+ 8/12 (½)(5.27)² 2 = 18.5	40.36	169.84	+ 747.3	+ 3144.6
	+ 8/12 (5.27)(7.45) = 26.2	41.24	169.84	+ 1079.4	+ 4445.4
Σ''	Σ'' = 2148.2			Σ'' = 72,834.8	339,574.5
Σ	82,490.4 ft³			2,669,419.9	2,934,832.6

$$\text{Weight} = 82{,}490.4\ ft^3 \times 150\ \frac{lb}{ft^3} \times \frac{1^k}{1000^{lb}} = 12{,}374^k$$

(compared to 11,789^k in DM-7) SH A-39

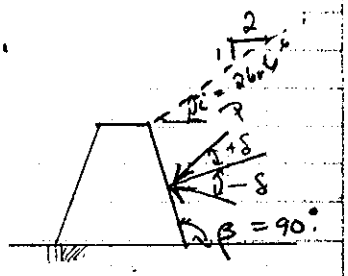
$$\bar{x} = \frac{\Sigma \bar{x}V}{\Sigma V} = \frac{2{,}669{,}419.9}{82{,}490.4} = 32.36\ ft$$

$$\bar{y} = \frac{\Sigma \bar{y}V}{\Sigma V} = \frac{2{,}934{,}832.6}{82{,}490.4} = 35.60\ ft$$

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

CONTROL TOWER

Calc. the coefficient K for rock fill.



$$K_r = \tan^2\left(45^\circ - \frac{\phi}{2}\right) = 0.45$$

$$= \frac{1-\cos 2(45-\frac{\phi}{2})}{1+\cos 2(45-\frac{\phi}{2})} \qquad \therefore \underline{\phi = 22^\circ}$$

$$K_a = \left[\frac{\csc\beta \cdot \sin(\beta-\phi)}{\sqrt{\sin(\beta+\delta)} + \sqrt{\frac{\sin(\phi+\delta)\cdot\sin(\phi-i)}{\sin(\beta-i)}}}\right]^2 \quad \text{... eq (3)}$$

EM1110-2-2502

$$\phi = i = 22$$

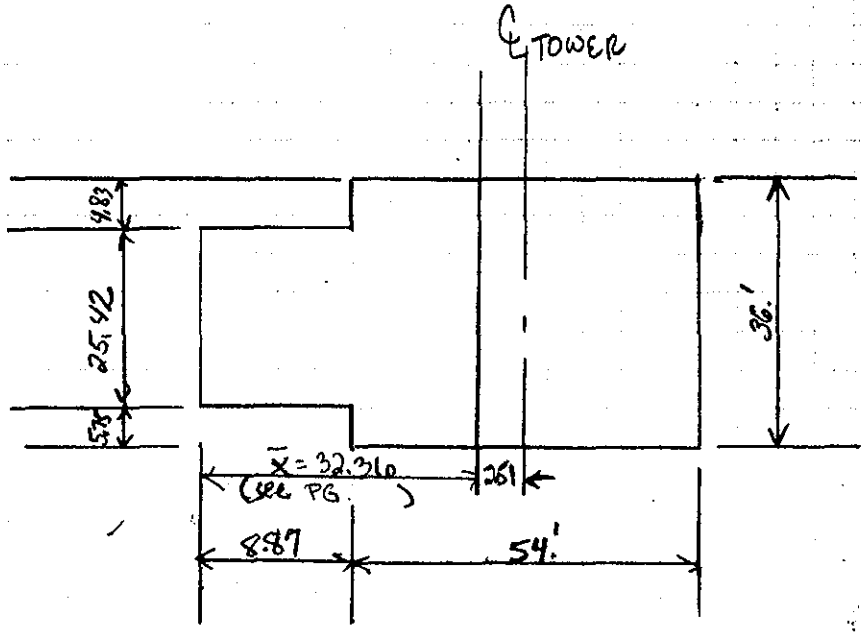
$$= \left[\frac{\left(\frac{1}{\sin 90}\right)^{1} \sin(90-22)}{\sqrt{\sin(90+0)}^{0} + \sqrt{\frac{\sin(22+90)\cdot\sin(22-22)}{\sin(90-26.6)}}^{0}}\right]^2$$

$$= \left[\frac{0.927}{1}\right]^2 = 0.86$$

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

GATE TOWER

Compute Base Area of Tower and Moment of Inertia of Area and Soil Pressures



$$A = (25.42 \times 8.87) + (54 \times 36) = \underline{2169.\ ft^2}$$

$$I = \left[\tfrac{1}{12}(36)(54)^3 + (54\times36)(2.51)^2\right] + \left[\tfrac{1}{12}(25.42)(8.87)^3 + (25.42\times8.87)(21.93)^2\right]$$

$$= 484{,}639.4 + 177{,}368.3$$

$$= \underline{662{,}008.\ ft^4}$$

$$R_1 = \tfrac{1}{2}(436.50-401)^2(.115)(.86) + (436.50-401)(.115)(.86)(401-395)$$
$$= 83.4^k$$

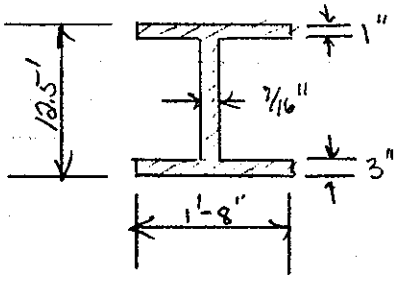
$$R_2 = \tfrac{1}{2}(6)^2(.125)(0.6) = 1.35^k$$

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

CONTROL TOWER

Compute weight of service bridge ($\ell = 154'$)

Girders — quantity 2



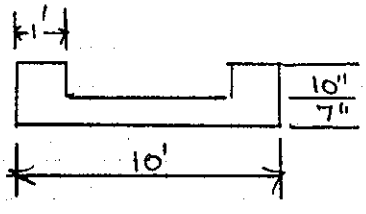
$[1.67(1/12)(154) + (.14375/12)(12)(12.08)(154) + 1.67(3/12)(154)] \times 2 \times 490\ lb/ft^3$ $\underline{150,480^{lb}}$

Diaphragms — quant = 5

36 WF150 @ $\ell = 7.5'$

$(150)(7.5) \times 5 = \underline{5625^{lb}}$

Deck



$(7/12)(12)(154)(150) = \underline{161,700}$

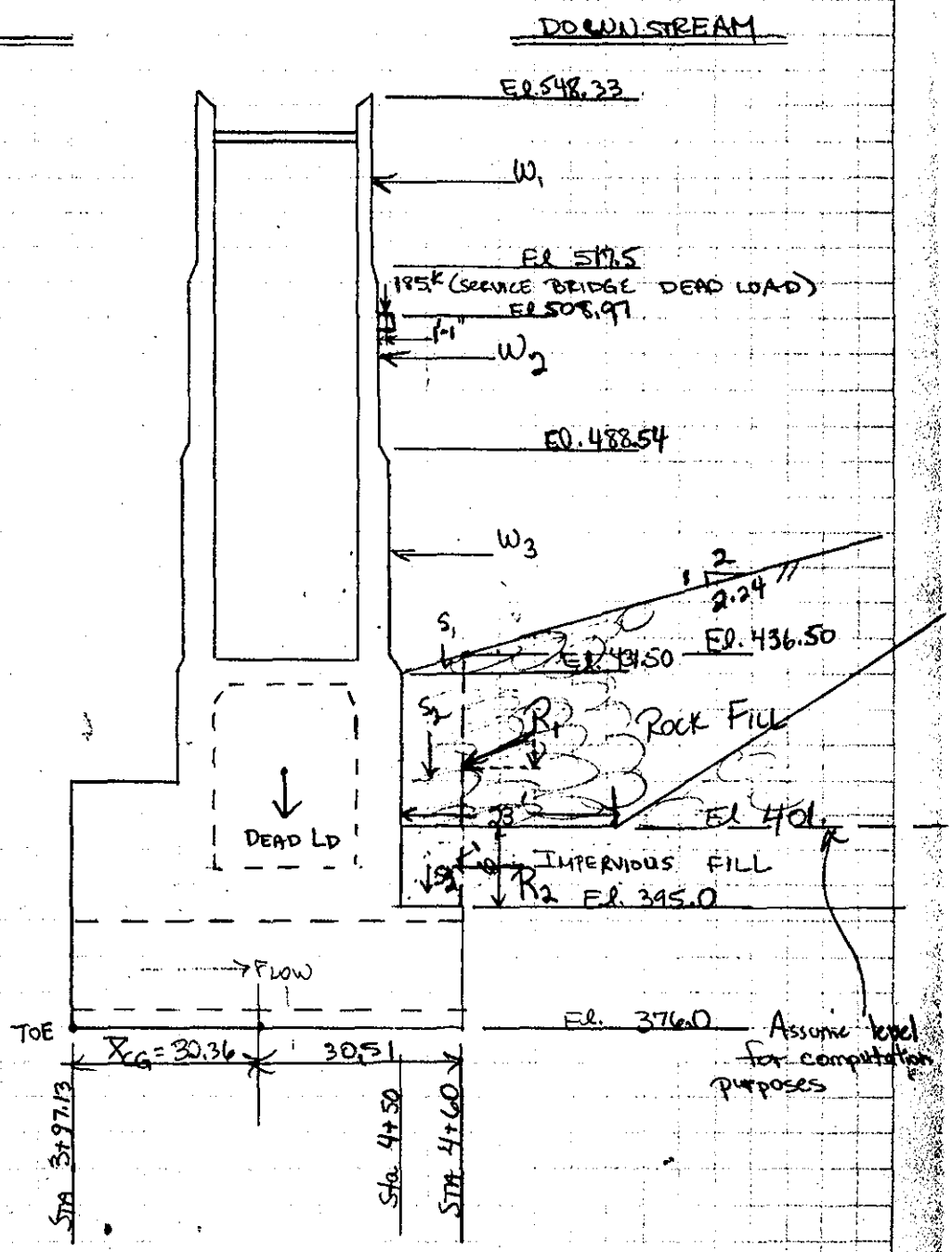
$2[(1 \times 10/12 \times 154)]150 = \underline{38,500}$

$356,305^{lb}$

Weight of bridge on control tower $= 356,305 \div 2 \cong \underline{180^k}$ say $\underline{185^k}$

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

LOAD CASE I



Note: Assume wind acts perpendicular over full width of tower.

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

Gate Tower

Load Case I

- Neglect friction of fill on tower.
- Bond shear value = 80psi and coeff. of friction = 0.5 for rock foundation.

ITEM	COMPUTATION	HORIZ. FORCE (K)	VERT. FORCE (K)	MOM. ARM (FT)	MOM. ABOUT TOE (K-FT)
TOWER DEAD LD.	SEE PG.	—	12,374.0	32.36	+400,422.6
S_1	(0.115)(1/2)(10)(5)(36)	—	103.5	59.54	+6162.4
S_2	(0.115)(10)(30.5)(36)	—	1262.7	57.87	+73,072.1
S_3	(0.125)(10)(6)(36)	—	270.0	57.87	+15,624.9
W_1	-(0.30)(30.83)(20)	-185.0	—	156.9	-29,026.5
W_2	-(0.30)(28.96)(21)	-182.4	—	127.02	-23,168.4
W_3	-(0.30)(57.04)(22)	-376.5	—	84.02	-31,633.5
SERVICE BRIDGE DL	SEE PG	—	185.0	46.45	+8593.0
R_1	-(2/2.24)(83.4)	-74.46	—	36.83	-2742.4
	(1/2.24)(83.4)	—	37.23	62.87	+2340.2
R_2	-(2/2.24)(1.35)	-1.20	—	21.0	-25.2
	(1/2.24)(1.35)	—	0.60	62.87	+37.9
Σ		-819.56	14,233.0		419,657.9

LOCATION OF RESULTANT = 419,657.9/14,233.0 = 29.48 from toe

IN KERN OK.

Compute base pressures $f = P/A \pm Mc/I$

$$f_{heel} = \frac{14,233.0}{2169} + \frac{(14,233.0)(\overset{2.88}{32.36-29.48})(30.5)}{662,008} = 8.5$$

$$f_{toe\ (upstream)} = \frac{14,233.0}{2169} - \frac{(14,233.0)(32.36-29.48)(32.36)}{662,008} = 4.56$$

$$F.S._{SLIDING} = \frac{14,233.0(.5)+0.08(62.87)(30)(44)}{819.56} = 35.2 > 2.0 \text{ ok}$$

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

GATE TOWER – LOAD CASE IA Accel. = 0.10 g (in upstream dir.)

ITEM	COMPUTATION	→ + K HORIZ. FORCE	K VERT. FORCE	FT MOM. ARM	K-ft MOM. ABOUT TOE ↻ = +
Dead load	See PG.	—	12,374.0	32.36	400,422.6
S_1	(.115) ½(10)(5)(36)	—	103.5	59.54	6162.4
	−(.115) ½(10)(5)(36)(.10)	−10.35	—	57.17	−591.7
S_2	(.115)(10)(30.5)(36)	—	1262.7	57.87	73,072.4
	−(.115)(10)(30.5)(36)(.10)	−126.27	—	40.25	−5082.4
S_3	(0.125)(10)(6)(36)	—	270.0	57.87	15,624.9
	−(.125)(10)(6)(36)(.10)	−27.0	—	22.0	−594.0
Bridge D.L.	See PG.	—	185.0	46.45	8593.0
Inertia	−12,374.(0.10)	1237.4	—	35.60	−44051.4
"	−185.(0.10)	−18.5	—	132.97	−2459.9
R_1	−(2/2.24)(83.4)	−74.46	—	36.83	−2742.4
	(1/2.24)(83.4)	—	37.23	62.87	2340.7
R_2	−(2/2.24)(1.35)	−1.20	—	21.0	−25.2
	(1/2.24)(1.35)	—	0.60	62.7	+37.9
Σ		−1495.2	14,233.0		450,706.9

LOCATION OF RESULTANT = 450,706.9 / 14,233 = 31.67 ↓ WITHIN KERN

Compute base pressures $f = P/A \pm Mc/I$

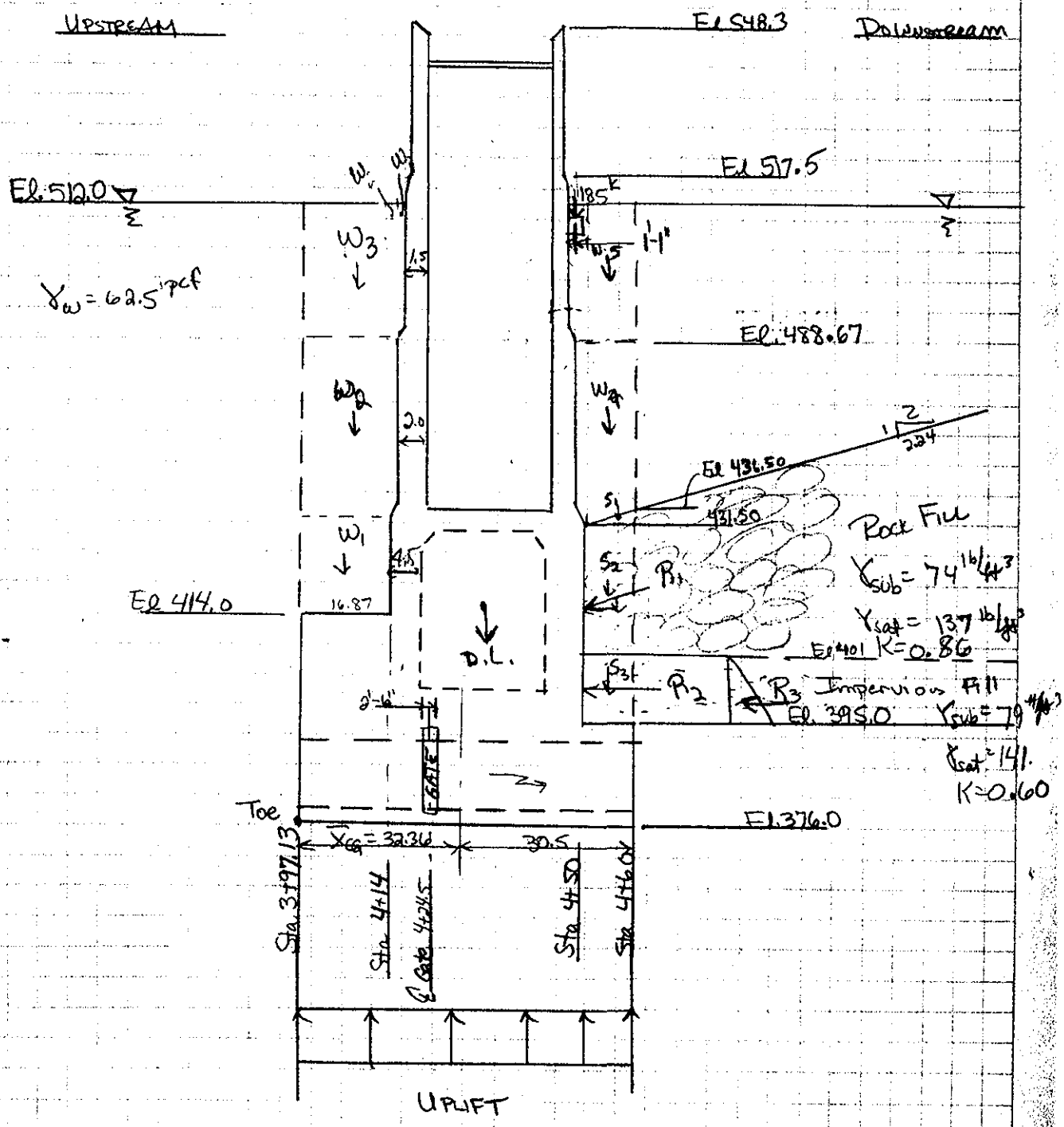
$$f_{downstream} = \frac{14233.0}{2169} + \frac{14233(\overbrace{32.36-31.67}^{.69})(30.51)}{662{,}008} = 7.0 \text{ ksf}$$

$$f_{upstream} = \frac{14233.0}{2169} - \frac{14233(32.36-31.67(32.36)}{662{,}008} = 6.1 \text{ ksf}$$

$$\text{F.S. SLIDING} = \frac{14{,}233.0(0.5) + 0.08(62.87)(30)(44)}{1495.2} = 19.3 > 2.0 \text{ ok}$$

SUBJECT: THOMASTON DAM
COMPUTATION: REVIEW OF STABILITY
COMPUTED BY: RK CHECKED BY: DATE:

GATE TOWER — LOAD CASE V (WATER AT MAX. SURCHARGE LEVEL = 512.0)



SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

CONTROL TOWER

LOAD CASE V - Compute Soil Pressures & Uplift

$R_1 = [\frac{1}{2}(35.5)^2(0.86)(0.137)(36) + \frac{1}{2}(35.5)^2(.86)(.074)(36)] = 411603$

$R_2 = [(35.5)(0.45)(0.137)(36) + (35.5)(.45)(0.074)(36)] = 121.3$

$R_3 = [\frac{1}{2}(6)^2(0.141)(0.6)(36) + \frac{1}{2}(6)^2(.079)(0.6)(36)] = 85.5$

<u>Compute Uplift</u> (Base Area = 2169 ft²)

Uplift = $(0.0625)(512 - 376)(2169) = -18,436.5^k$

Neglect friction forces

<u>Compute wt of Water in Gate Tower & Moment about Toe</u>

WT		Mom Arm		Mom. ↻+
$(.0625)(9.25)(10)(5.67) = 32.78$	×	9.25/2	=	151.6

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT THOMASTON DAM
COMPUTATION REVIEW OF STABILITY
COMPUTED BY RK CHECKED BY DATE

CONTROL TOWER – LOAD CASE V

ITEM	COMPUTATION	$\xrightarrow{+}$ K HORIZ. FORCE	$\downarrow +$ K VERT. FORCE	FT MOM. ARM	K-FT MOM. ABT TOE ↺ = +
Dead Load Tower	see pg.	—	12,374.0	32.36	400,422.6
" Bridge	see pg.	—	185.0	46.45	8593.0
W_1	(17.5)(16.87)(36)(.0625)	—	664.3	8.44	5606.7
W_2	(57.17)(23.87)(22)(.0625)	—	1876.4	11.94	22,404.1
W_3	(23.33)(24.37)(21)(.0625)	—	746.2	12.19	9096.5
W_4	(57.17)(17)(22)(.0625)	—	1336.3	54.37	72,657.3
W_5	(23.33)(17.5)(21)(.0625)	—	535.9	54.12	29,000.8
S_1	1/2(10)(8)(36)(.137)	—	123.3	59.54	7341.3
S_2	(10)(30.5)(36)(.137)	—	1504.3	57.87	87,051.5
S_3	(10)(6)(36)(.141)	—	304.6	57.87	17,624.9
WATER IN TOWER	see pg	—	32.78	4.625	151.6
UPLIFT	see pg.	—	− 18,436.5	31.44	− 579,643.6
R_1	−(2/2.24)(4116.3)	− 3675.3		36.83	− 135,360.1
	(1/2.24)(4116.3)		+ 1837.6	62.87	+ 115,532.1
R_2	see pg.	− 121.3	—	22.0	− 2668.6
R_3	see pg "	− 85.5	—	22.0	− 1881.0
Σ		− 3882.1	3084.2		55,929.1

Location of Resultant = 55,929.1 / 3084.2 = 18.13 from toe (within base)

Compute base pressures $f_{MAX} = 2\Sigma V / \text{Bearing Area}$

Length of base in bearing = 3(18.13) = 54.39'

Area of base in bearing = (8.87×25.42) + (45.52×36) = 1864.2 ft²

f_{max} = 2(3084.2)/1864.2 = 3.3 ksf < 20 ksf ok

% base in bearing = 54.39/62.87 = 86.5%

$$F.S._{SLIDING} = \frac{3084.2(0.5) + 0.08(62.87)(32)(144)}{3882.1} = 6 > 2 \text{ ok}$$

Stability Analysis of Control Tower

Section (1)	Loading Case	Location of Resultant: In Middle Third	Location of Resultant: In Base	Sliding Factor of Safety (2)	Length of Base in Bearing (ft)	Bearing Pressure on Rock K/S.F.: Upstream	Bearing Pressure on Rock K/S.F.: Downstream
Control Tower Upstream-Downstream Direction	I	YES	--	35.2	62.87	4.56	8.5
	V	--	YES	6.0	54.39	3.3	0.00
	IA	YES	—	19.3	62.87	6.1	7.0

Ht = 172.0 ft
Base = 62.87 ft

(1) See Plate for details

(2) Factor of Safety computed with bond shear value of 80 psi and coefficient of friction of 0.5.

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: THOMASTON STABILITY – EAST INTAKE CHANNEL WALL
COMPUTATION: Computer Runs – Summary Sheet
COMPUTED BY: ENestorides CHECKED BY: DATE: Sept. 15, 1986

TSIEWIA – 3A: SERIES

Section and Criteria Description	Load Case 2 (Load Case I EM 1110-2-2400)	Load Case 6 (Load Case Ia)
Section 1A:		
final shear f.o.s.	64.8	31.1
Effective Base	100%	72.3%
Overturning criteria	OK	OK (>0%)
Max. Base Pressure criteria	OK	OK
Sliding Criteria	OK	OK
Stability Achieved?	— Yes —	— Yes —
Section 2A:		
final Shear F.O.S.	23.4	7.9
Effective Base	98.2%	45.5%
Overturning criteria	No (<100%)	OK (>0%)
Max Base Pressure criteria	OK	OK
Sliding Criteria	OK	OK
Stability achieved?	— YES — *	— Yes —
Section 3A:		
final Shear F.O.S.	18.2	4.02
Effective Base	82.4%	22.2%
Overturning Criteria	No (<100%)	OK (>0%)
Max. Base Pressure Criteria	OK	OK
Sliding Criteria	OK	OK
Stability achieved?	— YES — *	— Yes —

These computer runs did not include water behind the wall, since the rock fill is free draining.

* Based on criteria from the revised Retaining wall manual, the minimum area required to be in compression for a rock foundation is 75%. The computer program analyses gravity dams which requires 100% effective base, however since this is a gravity retaining wall we feel the 75% minimum is sufficient.

BOTH SECTIONS ARE THEREFORE STABLE As per Corps Criteria.

12

TABLE 4-1. Retaining Wall Stability Criteria

Case No.	Loading Condition	Factor of Safety, FS	Shear Strength Test Required		Minimum Base Area In Compression		Minimum Bearing Capacity Safety Factor
			Soil Foundation	Rock Foundation(3)	Soil Foundation	Rock Foundation	
R1	Usual	1.5	(Q &/or S)(2)(1)	Direct Shear	100%	75% (4)	3.0
R2	Extreme	1.33	(Q &/or S)(2)(1)	Direct Shear	75%	50% (4)	2.0
R3	Earthquake	1.1	(Q)	Direct Shear	Resultant Within Base	Resultant Within Base	NA

1. For soil foundations which are not free draining (permeability < 10×10^{-4} cm/sec), analyze for both Q and S strengths and design for the worst condition. For free draining soil foundations (permeability ≥ 10×10^{-4} cm/sec), analyze for S strengths only.

2. For construction loadings in cases R1 or R2, use Q strengths when excess pore water pressure in the soil foundation is anticipated and S strengths when it is not anticipated.

3. The sliding analysis of a wall on rock should be based on the frictional resistance (tan ϕ) of concrete on rock or rock on rock. The values should be obtained from direct shear tests of pre-cut samples of concrete on rock and rock on rock, or direct shear tests or natural rock joints or bedding planes.

4. Less base area in compression than the minimum shown may be acceptable provided adequate safety against excessive differential settlement and bearing failure is obtained.

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT THOMASTON DAM STABILTY REVIEW
COMPUTATION Sample CDAMS Input file
COMPUTED BY E Nestorides CHECKED BY DATE 9-26-86

CDAMS INPUT FILE

10 TITLE
20 Allowable bearing, ϕ angle, shear strength
30 Elevation of upstream soil layer
40 γ_{dry}, γ_{boyant}, K (upstream layer)
50 Elevation of downstream soil layer
60 γ_{dry}, γ_{boyant}, K (downstream layer)
70 γ_{water}, wind pressure, seismic coefficient
80 Normal headwater elevation, Tailwater elevation
90 Induced headwater elevation, Tailwater elevation
100 Flood headwater elevation, Tailwater elevation
110 Type of Section, Depth, Unit Weight, No. of Gallaries
120 X drain, % effective
130 X_5, ELHEEL, X_{502}, EL50, SLP51
140 HEEL, X504, ELBK, USLP
150 EL52, X505, EL53, SLP53
160 EL54, X506, EL55
170 X507, EL56, SLP54
180 EL57, EL58, SL54
190 Toe, EL toe, BSLP
200 Anchor Load, Xanchor, Yanchor, ELanchor
210 Misc Load, X misc, y misc, EL misc.
220 Ice load, Thickness

See Geometric Figure below

The above file was used for the following sections.

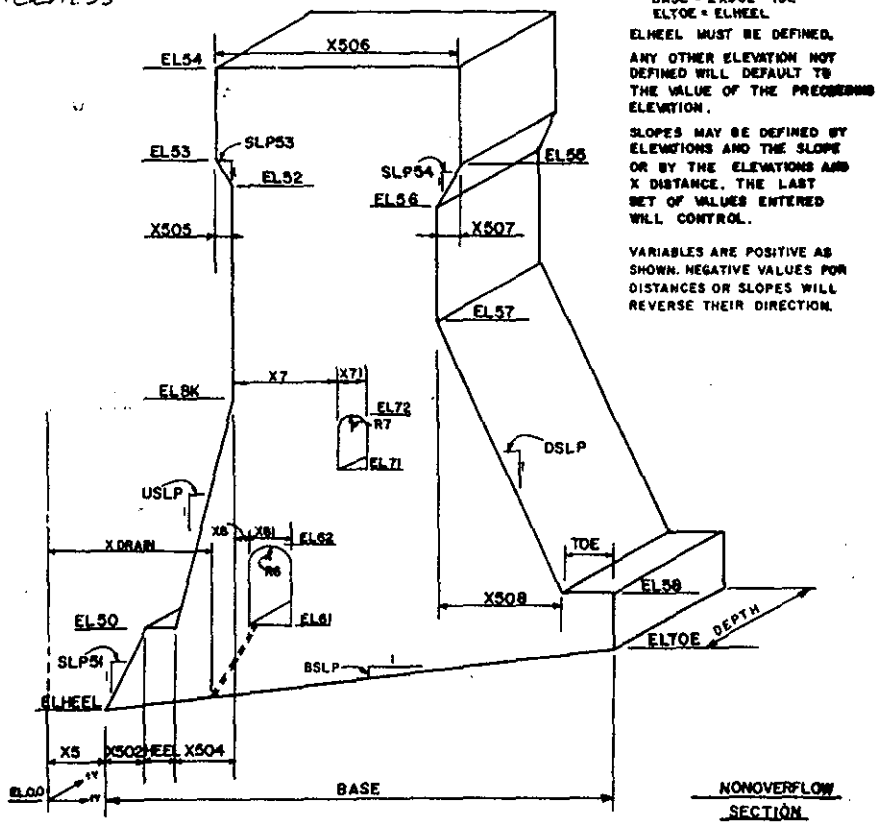


Figure 6. Nonoverflow monolith

3DSAD program
Gravity Structures, etc. Load Cases

CHAPTER 3
STABILITY

3-01. LOADING CONDITIONS. The following loading conditions and requirements are suitable in general for gravity dams of moderate height. Loads which are not indicated, such as wave action, or any unusual loadings should be considered where applicable. Power intake sections should be investigated with emergency bulkheads closed and all water passages empty.

I. *Construction Condition.* Dam completed but no water in reservoir, no tailwater, wind load on downstream face.

II. *Normal Operating Condition.* Pool elevation at top of closed spillway gates, where spillway is gated; and at spillway crest, where spillway is ungated. Minimum tailwater elevation for gated and ungated spillways. Ice pressure, if applicable.

III. *Induced Surcharge Condition.* Pool elevation at top of partially opened gate. Tailwater pressure at full value for non-overflow section and 60 percent of full value for overflow section. Ice pressure if applicable.

IV. *Flood Discharge Condition.* Reservoir at maximum flood pool elevation. All gates open and tailwater at flood elevation. Tailwater pressure at full value for nonoverflow section and 60 percent of full value for overflow sections for all conditions of deep flow over spillway, except that full value will be used in all cases for computation of the uplift. No ice pressure.

V. *Construction Condition with Earthquake.* Earthquake acceleration in a downstream direction. No water in reservoir. No wind load. No tailwater.

VI. *Normal Operating Condition with Earthquake.* Earthquake acceleration in an upstream direction. Reservoir at top of closed gate for gated spillways and at spillway crest for ungated spillways. Minimum tailwater. No ice pressure.

3-02. STABILITY REQUIREMENTS. The basic requirements for stability of a gravity dam for all conditions of loading are:

(1) That it be safe against overturning at any horizontal plane within the dam, at the base or at a plane below the base.

(2) That it be safe against sliding on any horizontal plane within the dam, on the foundation, or on any horizontal or nearly horizontal seam in the foundation.

(3) That allowable unit stresses in the concrete or in the foundation material shall not be exceeded.

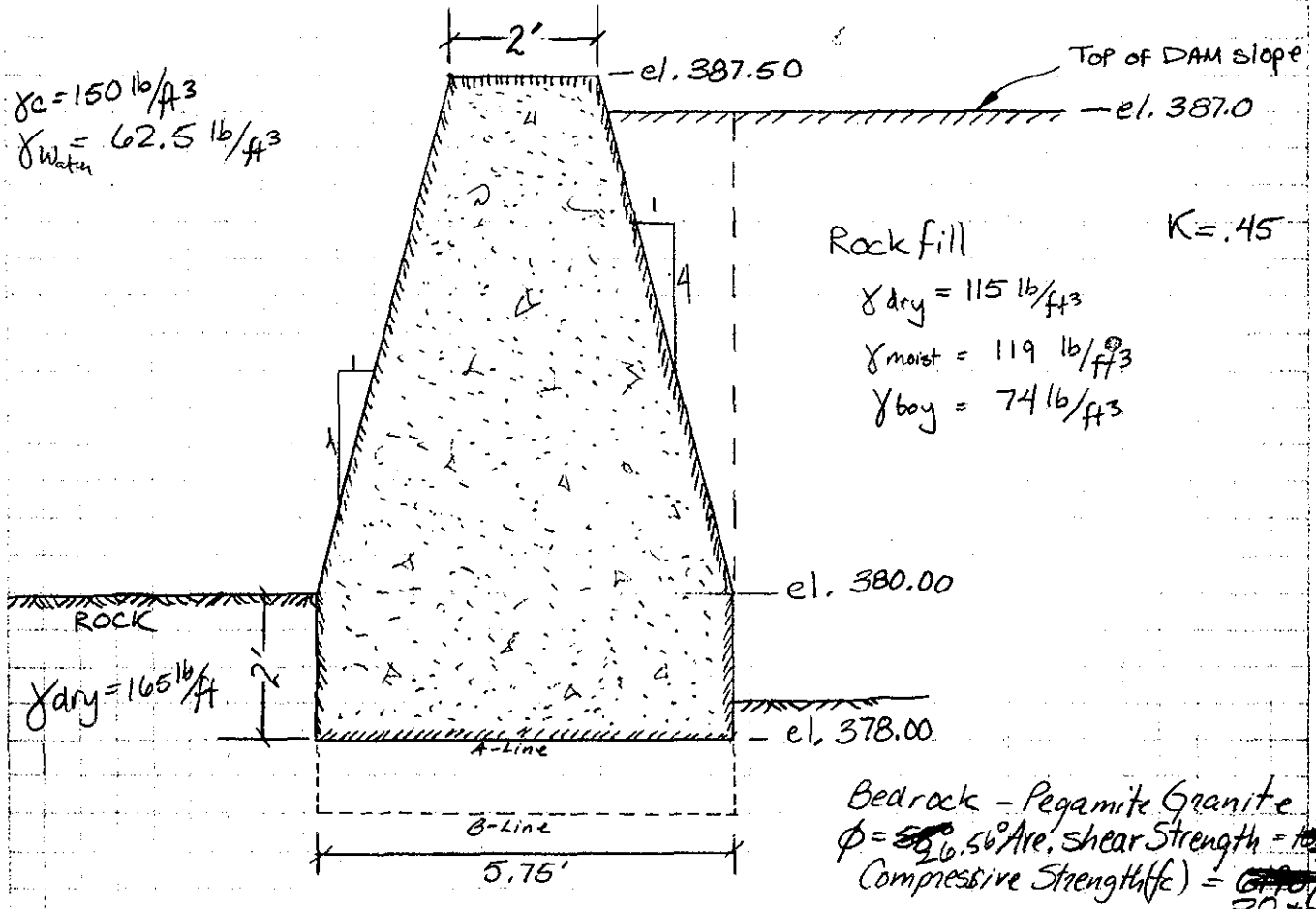
3-03. OVERTURNING AND SLIDING CRITERIA. When the resultant of all forces acting above any horizontal plane through a dam intersects that plane outside of the middle third, tensile stresses are set up. Since the tensile strength of concrete is usually considered to be zero, it is generally required for all normal loading that the resultant intersect the plane within the middle third. However, because of the short duration of earthquake forces, as discussed in paragraph 2-06, it is considered justifiable to modify this requirement when these forces are included, as indicated in table 1.

The horizontal forces acting on a dam tend to cause the structure to slide along horizontal planes. Resistance to sliding at or below the base is a function of the shearing strength of the foundation and at any plane above the base, the shearing strength of the concrete in the dam. Experience has shown that the shearing resistance of the foundation or concrete need not be investigated if the ratio of horizontal forces to vertical forces ($\Sigma H/\Sigma V$) is such that a reasonable safety factor against sliding results. This will require that the ratio of $\Sigma H/\Sigma V$ be well below the coefficient of sliding friction of the material.

Table 1 indicates acceptable limits of the location of the resultant and the maximum sliding factor for all loading conditions as outlined in paragraph 3-01. Where the sliding factor exceeds the values given, the shearing resistance should be investigated.

SUBJECT: THOMASTON DAM: INTAKE CHANNEL
COMPUTATION: East Retaining Wall Stability Analysis
COMPUTED BY: E Nestorides CHECKED BY: DATE: Sept. 9, 1986

Intake Channel: East Retaining Wall section at station 3+40.00.



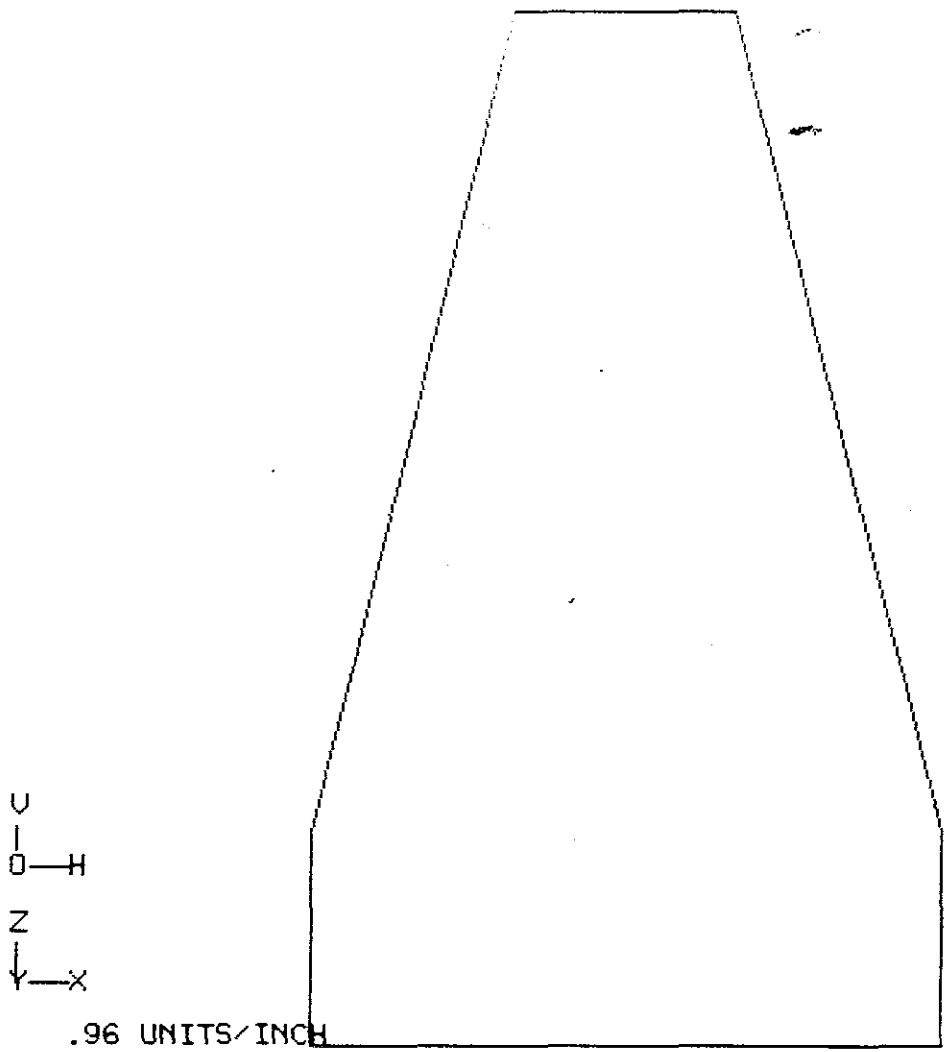
Weight: $(2ft \times 5.75\ ft \times 1ft) \times 150\ lb/ft^3 \Rightarrow 1725$ lbs
Conc.
$2\left(\frac{1}{2} \times 1.875\ ft \times 7.5ft \times 1ft\right) \times 150\ lb/ft^3 \Rightarrow 2109.375$ lbs.
$(2ft' \times 7.5ft \times 1ft) \times 150\ lb/ft^3 \Rightarrow 2250$ lbs.

Total $\Rightarrow 6084.4$ lbs.

This section was modeled and run on the CDAMS module of 3DSAD. The filename was TSIEWIA.

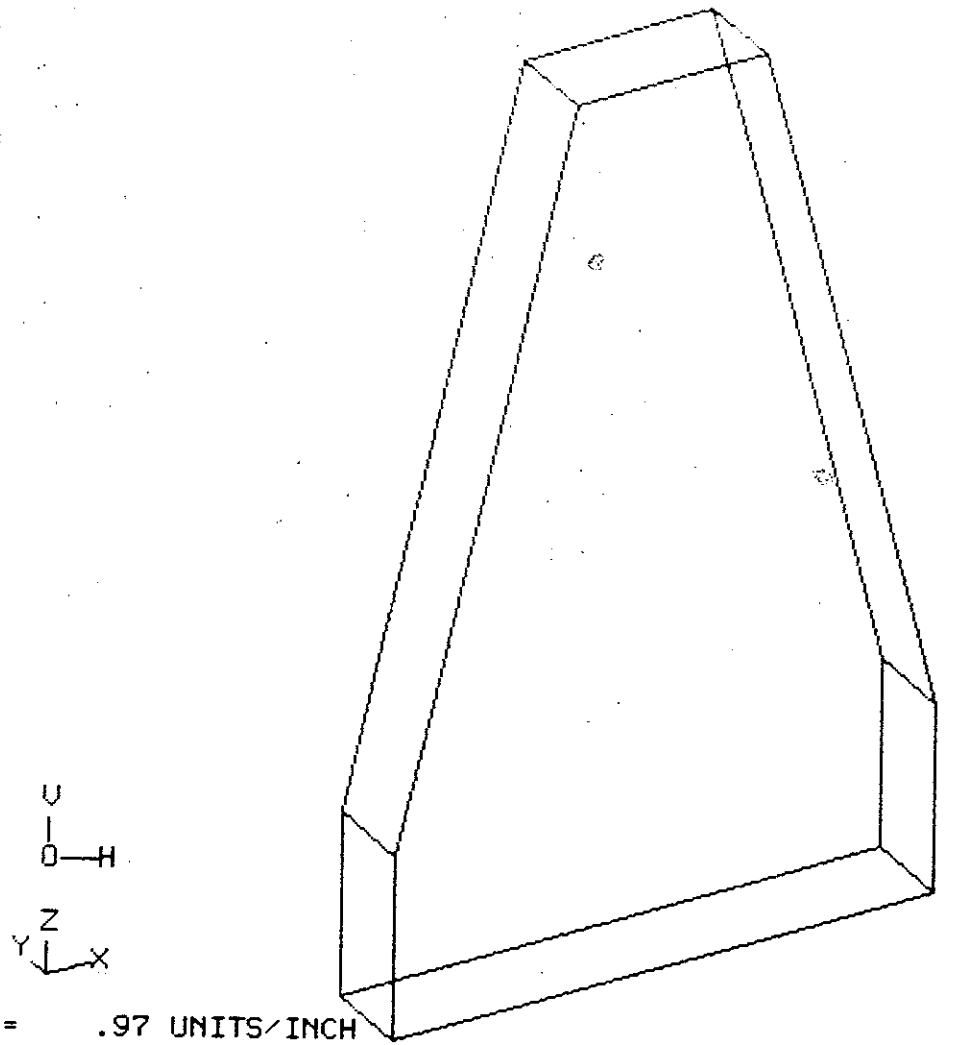
```
10 THOMASTON STABILITY - INTAKE:EAST WALL 1A
20 40000,26.56,23040
30 9
40 115,74,0.45
50 2
60 165,58,0
70 62.5,30,0.1
80 0,0
90 0,0
100 0,0
110 NONOVERFLOW,1,150,0
120 0,0
130 0,0,0,2,0
140 0,1.875,9.5,0.25
150 9.5,0,9.5,0
160 9.5,2.0,9.5
170 0,9.5,0
180 9.5,1.875,2.0,0.25
190 0,0,0
200 0,0,0,0,0
210 0,0,0,0,0
220 0,0
/
```

COMMAND



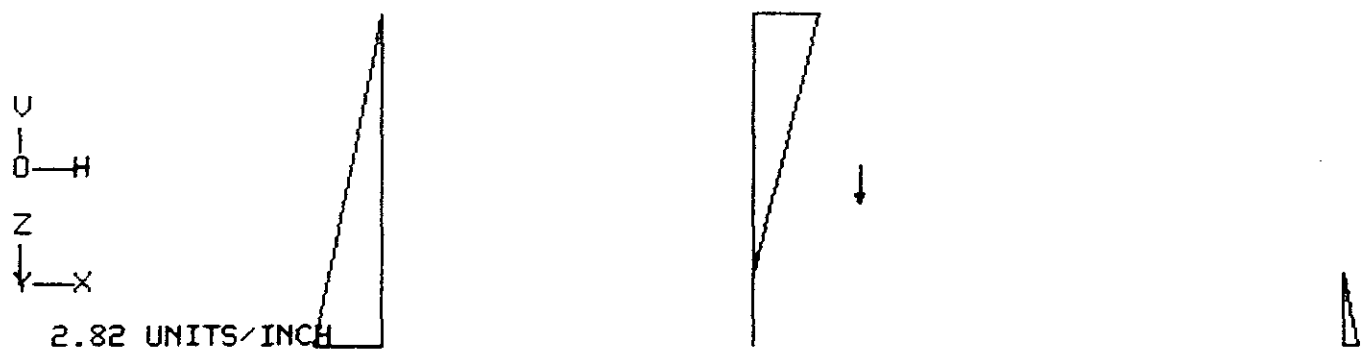
SF = .96 UNITS/INCH

COMMAND ?



SF = .97 UNITS/INCH

COMMAND ?



SF = 2.82 UNITS/INCH

FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	2095.48 -3394.38	0.00 24221.26	-6788.76 -1047.74

COMMAND ?
?

LOAD CASE I CATEGORY = 1

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	2095.480	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	24221.3	MZ =	-1047.7

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	5.750	0.000	0.000	0.000
C	5.750	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE I
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

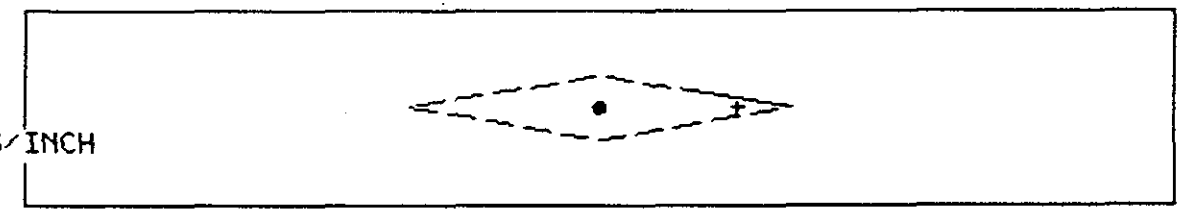
X ECC. = .69
Y ECC. = 0.00

R DIST = .05

YG
|
ZG—XG

YL
└—XL

SF = .53 UNITS/INCH



LOAD CASE ~~IX~~ I CATEGORY = 1

FINAL BASE AREA PROPERTIES

AREA =	5.750	IXP =	.5	IYP =	15.8
XBAR =	2.875	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	2095.480	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	24221.3	MZ =	-1047.7

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	2095.480	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	24221.3	MZ =	-1047.7

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	327.075
B	5.750	0.000	0.000	2034.233
C	5.750	1.000	0.000	2034.233
D	0.000	1.000	0.000	327.075

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

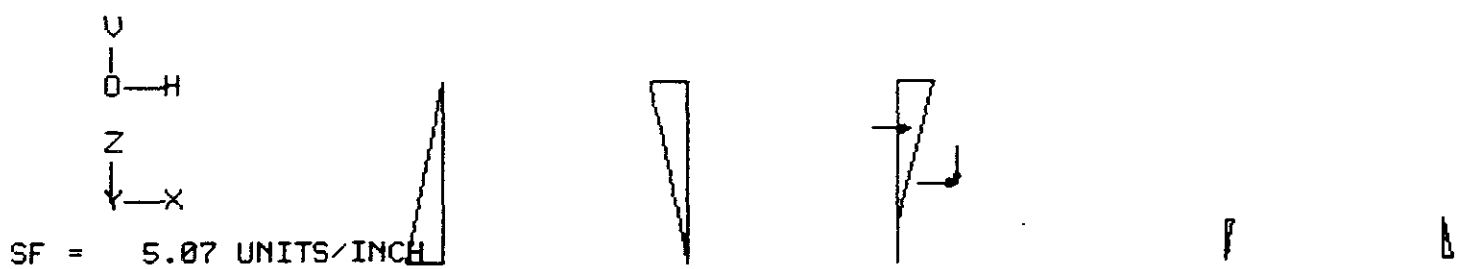
FACTOR OF SAFETY = 64.84

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

:U
COMMAND ?
?



SF = 5.07 UNITS/INCH

FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	3193.93 -3394.38	0.00 29621.92	-6788.76 -1596.96

COMMAND ?
?

LOAD CASE ~~NI~~ Ia CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	3193.930	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	29621.9	MZ =	-1597.0

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	5.750	0.000	0.000	0.000
C	5.750	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE I
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

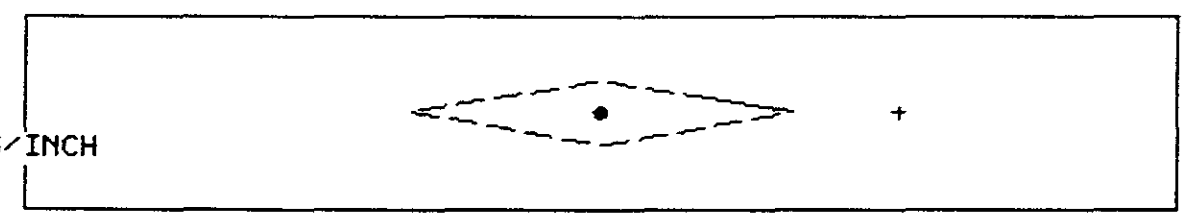
X ECC. = 1.49
Y ECC. = 0.00

R DIST = -.53

YG
|
ZG—XG

YL
|
└—XL

SF = .53 UNITS/INCH



LOAD CASE ~~XI~~ Ia CATEGORY = 3

COMPUTED BASE AREA PROPERTIES

AREA =	5.750	IXP =	.5	IYP =	15.8
XBAR =	2.875	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FORCES AND MOMENTS

--INPUT--

FX =	3193.930	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	29621.9	MZ =	-1597.0

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	3193.930	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	29621.9	MZ =	-1597.0

COMPUTED IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	-653.007
B	5.750	0.000	0.000	3014.315
C	5.750	1.000	0.000	3014.315
D	0.000	1.000	0.000	-653.007

COMPUTED SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 42.54

LOAD CASE Ia
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

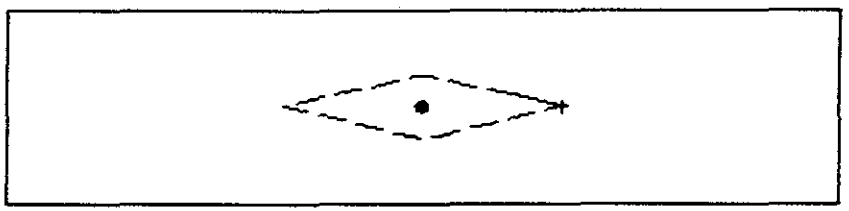
X ECC. = .69
Y ECC. = -.00

R DIST = -.00

YG
|
ZG—XG

YL
|
└—XL

SF = .53 UNITS/INCH



LOAD CASE Ia CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	4.160	IXP =	.3	IYP =	6.0
XBAR =	3.670	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	3193.930	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	29621.9	MZ =	-1597.0

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	3193.930	FY =	0.000	FZ =	-6788.760
MX =	-3394.4	MY =	29621.9	MZ =	-1597.0

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

B-A	1.590	0.000	0.000	-.000
B	5.750	0.000	0.000	3263.930
C	5.750	1.000	0.000	3263.930
C-D	1.590	1.000	0.000	-.000

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 31.07

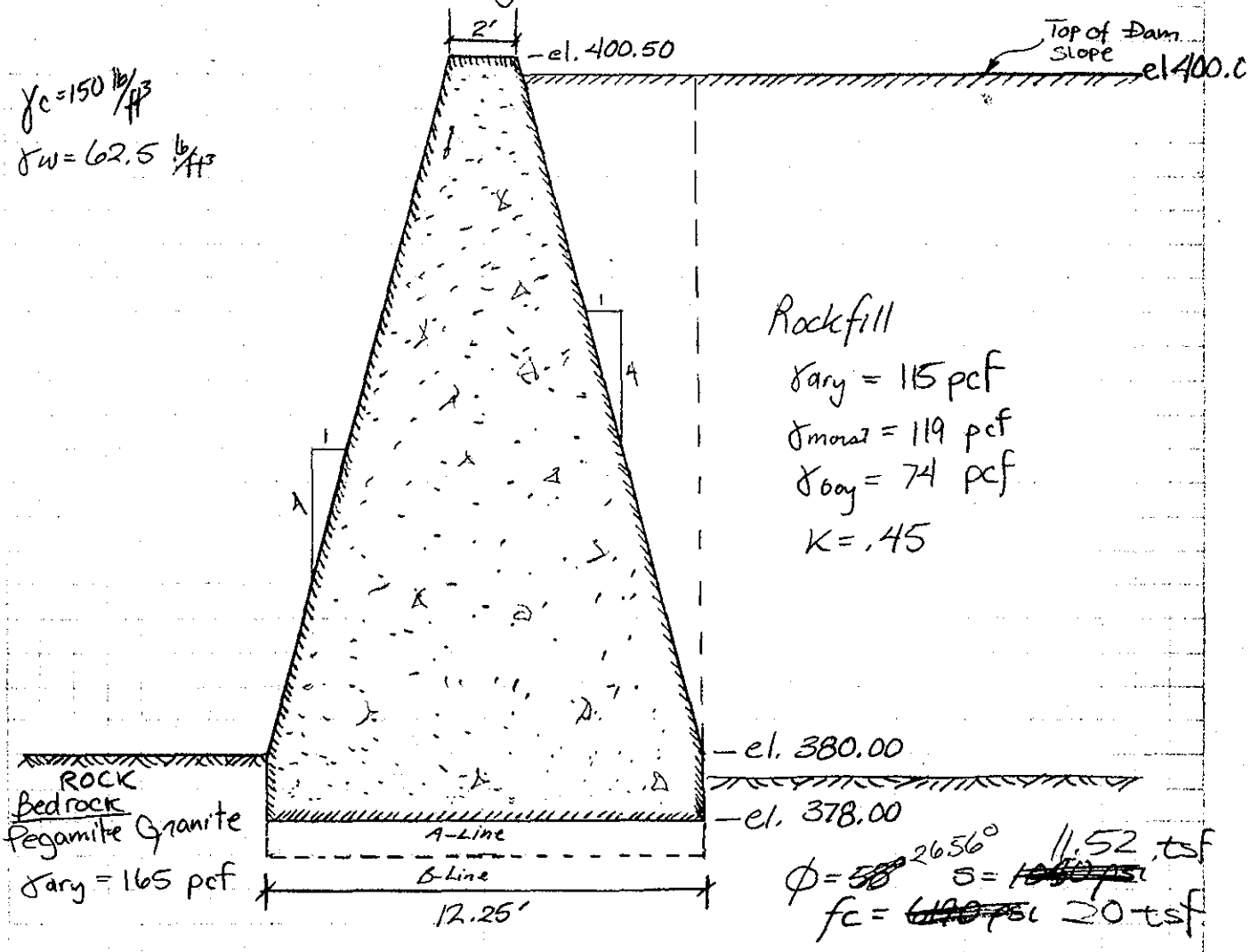
EFFECTIVE BASE = 72.3%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

SUBJECT THOMASTON DAM: INTAKE CHANNEL
COMPUTATION East Retaining Wall Stability Analysis
COMPUTED BY ENestorides CHECKED BY DATE Sept. 9, 1986

Intake Channel: East Retaining Wall section at station 3+66.00



Weight: $(2ft \times 12.25ft \times 1ft) \times 150$ lb/ft³ ⇒ 3675 lb.
conc.

$2(\frac{1}{2} \times 5.125ft \times 20.5ft \times 1ft) \times 150$ lb/ft³ ⇒ 15,759.375 lb

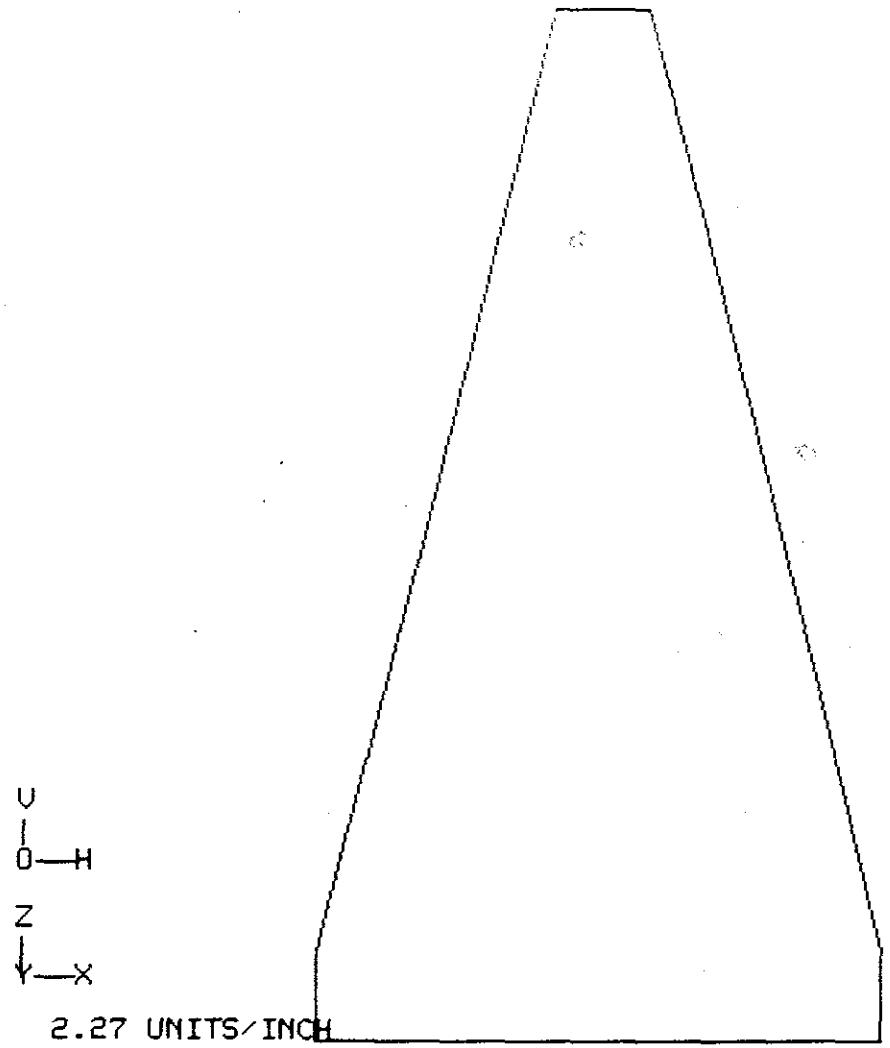
$(2ft \times 20.5ft \times 1ft) \times 150$ lb/ft³ ⇒ 6150

TOTAL: 25,584.4 lb

This section was modeled and run on the CDAMS module of 3DSAD. The filename was TSIEWZA.

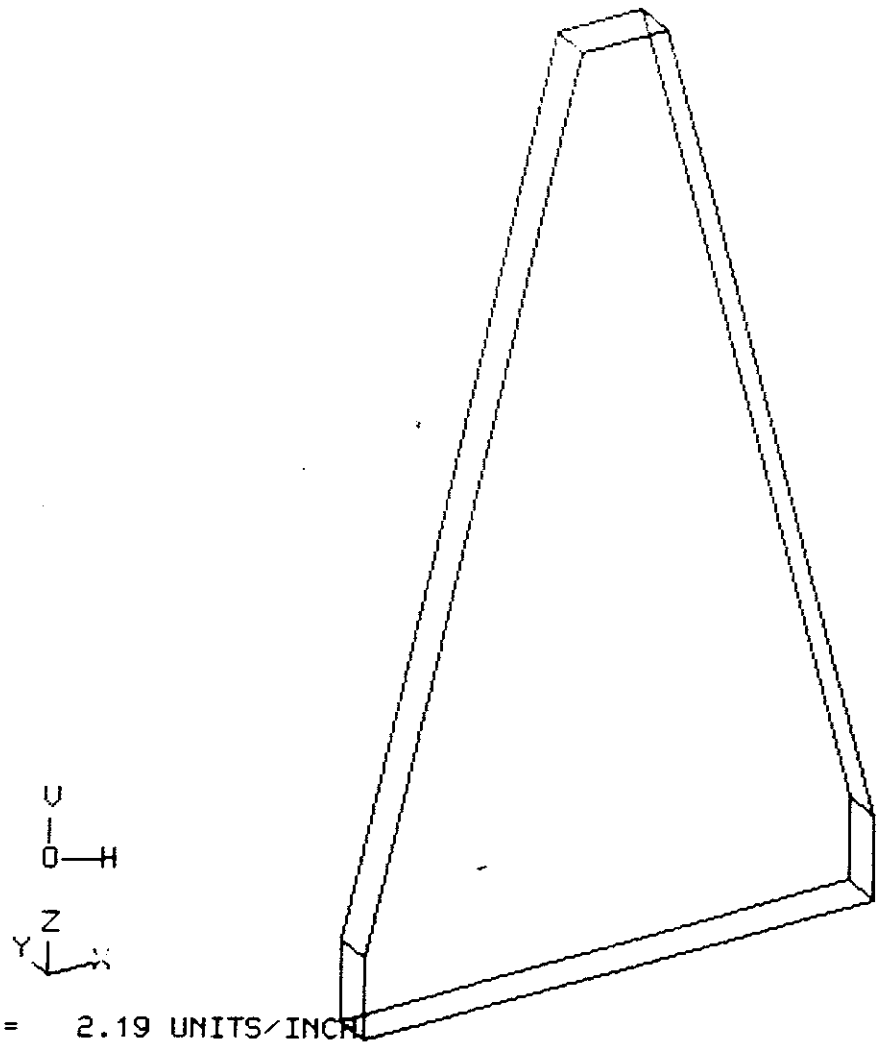
```
10 THOMASTON STABILITY - INTAKE:EAST WALL 2A
20 40000,26.56,23040
30 22
40 115,74,0.45
50 2
60 165,58,0
70 62.5,30,0.1
80 0,0
90 0,0
100 0,0
110 NONOVERFLOW,1,150,0
120 0,0
130 0,0,0,2,0
140 0,5.125,22.5,0.25
150 22.5,0,22.5,0,
160 22.5,2,22.5
170 0,22.5,0
180 22.5,5.125,2,0.25
190 0,0,0
200 0,0,0,0,0
210 0,0,0,0,0
220 0,0
/
```

COMMAND ?



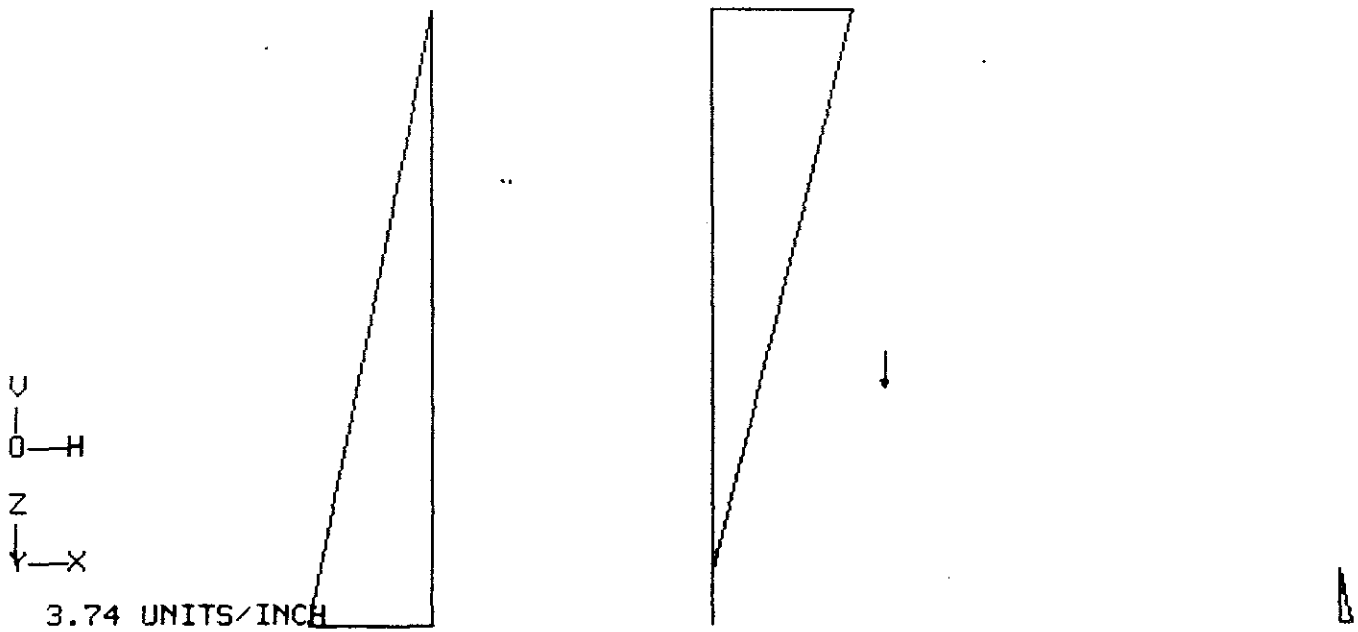
SF = 2.27 UNITS/INCH

COMMAND ?



SF = 2.19 UNITS/INCH

COMMAND ?



SF = 3.74 UNITS/INCH

FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	12523.10 -15667.19	0.00 258254.32	-31334.38 -6261.55

COMMAND ?
?

LOAD CASE I CATEGORY = 1

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	12523.100	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	258254.3	MZ =	-6261.6

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	12.250	0.000	0.000	0.000
C	12.250	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE I
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

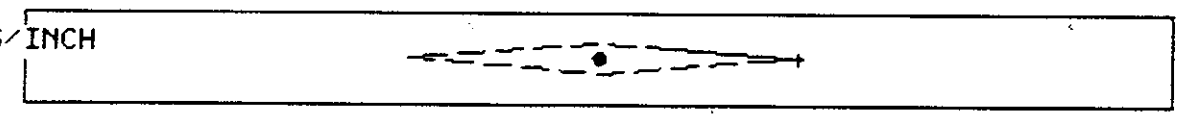
X ECC. = 2.12
Y ECC. = 0.00

R DIST = -.08

YG
|
ZG—XG

YL
|
└—XL

SF = 1.13 UNITS/INCH



LOAD CASE I CATEGORY = 1

COMPUTED BASE AREA PROPERTIES

AREA =	12.250	IXP =	1.0	IYP =	153.2
XBAR =	6.125	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FORCES AND MOMENTS

--INPUT--

FX =	12523.100	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	258254.3	MZ =	-6261.6

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	12523.100	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	258254.3	MZ =	-6261.6

COMPUTED IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	-94.236
B	12.250	0.000	0.000	5210.053
C	12.250	1.000	0.000	5210.053
D	0.000	1.000	0.000	-94.236

COMPUTED SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 23.79

LOAD CASE I
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

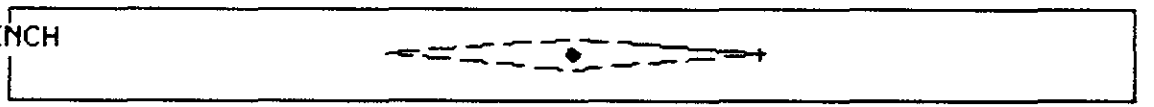
X ECC. = 2.00
Y ECC. = 0.00

R DIST = -.00

YG
|
ZG—XG

YL
└—XL

SF = 1.13 UNITS/INCH



LOAD CASE ~~IX~~ I CATEGORY = 1

FINAL BASE AREA PROPERTIES

AREA =	12.024	IXP =	1.0	IYP =	144.9
XBAR =	6.238	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	12523.100	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	258254.3	MZ =	-6261.6

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	12523.100	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	258254.3	MZ =	-6261.6

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

B-A	.226	0.000	0.000	-.000
B	12.250	0.000	0.000	5211.822
C	12.250	1.000	0.000	5211.822
C-D	.226	1.000	0.000	-.000

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

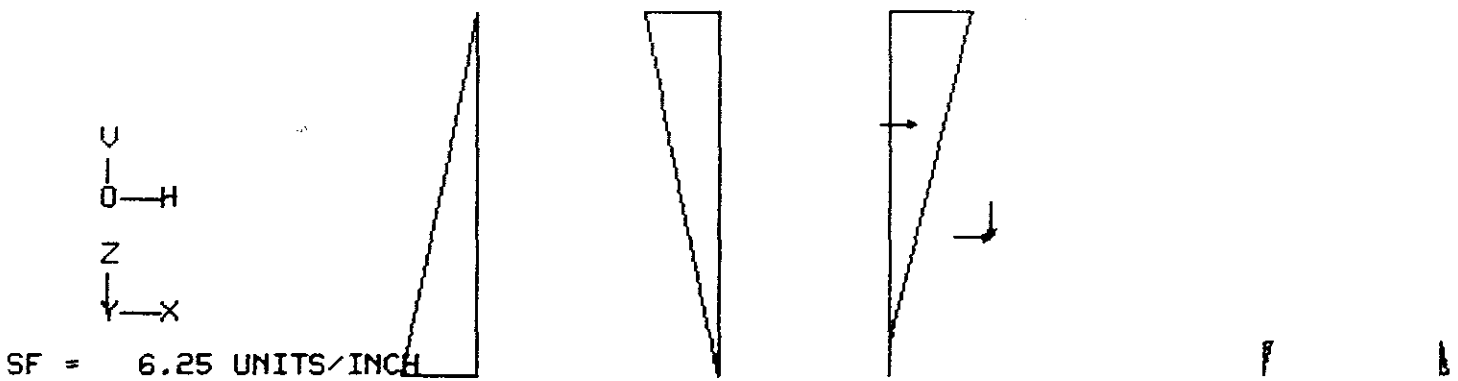
FACTOR OF SAFETY = 23.38

EFFECTIVE BASE = 98.2%

OVERTURNING CRITERIA NOT MET
PEREFF = 98.16% REQUIRED = 100.00%

MAXIMUM BASE PRESSURE CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED

COMMAND ?
?



FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	18161.64 -15667.19	0.00 325630.59	-31334.38 -9080.82

COMMAND ?
?

LOAD CASE ~~XI~~ Ia CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	18161.640	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	325630.6	MZ =	-9080.8

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	12.250	0.000	0.000	0.000
C	12.250	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE 1a
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

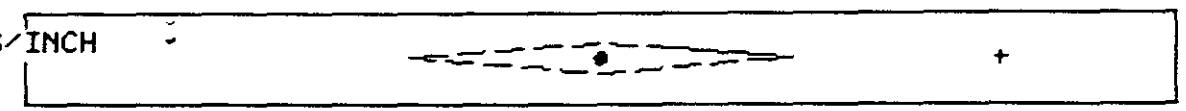
X ECC. = 4.27
Y ECC. = 0.00

R DIST = -2.23

YG
ZG—XG

YL
XL

SF = 1.13 UNITS/INCH



LOAD CASE 10 CATEGORY = 3

COMPUTED BASE AREA PROPERTIES

AREA =	12.250	IXP =	1.0	IYP =	153.2
XBAR =	6.125	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FORCES AND MOMENTS

--INPUT--

FX =	18161.640	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	325630.6	MZ =	-9080.8

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	18161.640	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	325630.6	MZ =	-9080.8

COMPUTED IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	-2788.164
B	12.250	0.000	0.000	7903.982
C	12.250	1.000	0.000	7903.982
D	0.000	1.000	0.000	-2788.164

COMPUTED SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 16.40

LOAD CASE ~~DI~~ Ia
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

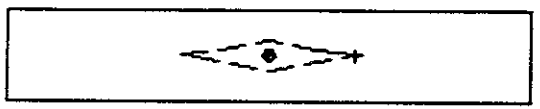
X ECC. = .93
Y ECC. = 0.00

R DIST = -.00

YG
|
ZG—XG

YL
|
└—XL

SF = 1.13 UNITS/INCH



LOAD CASE Ia CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	5.574	IXP =	.5	IYP =	14.4
XBAR =	9.463	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	18161.640	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	325630.6	MZ =	-9080.8

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	18161.640	FY =	0.000	FZ =	-31334.380
MX =	-15667.2	MY =	325630.6	MZ =	-9080.8

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

B-A	6.676	0.000	0.000	-.000
B	12.250	0.000	0.000	11243.767
C	12.250	1.000	0.000	11243.767
C-D	6.676	1.000	0.000	-.000

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 7.93

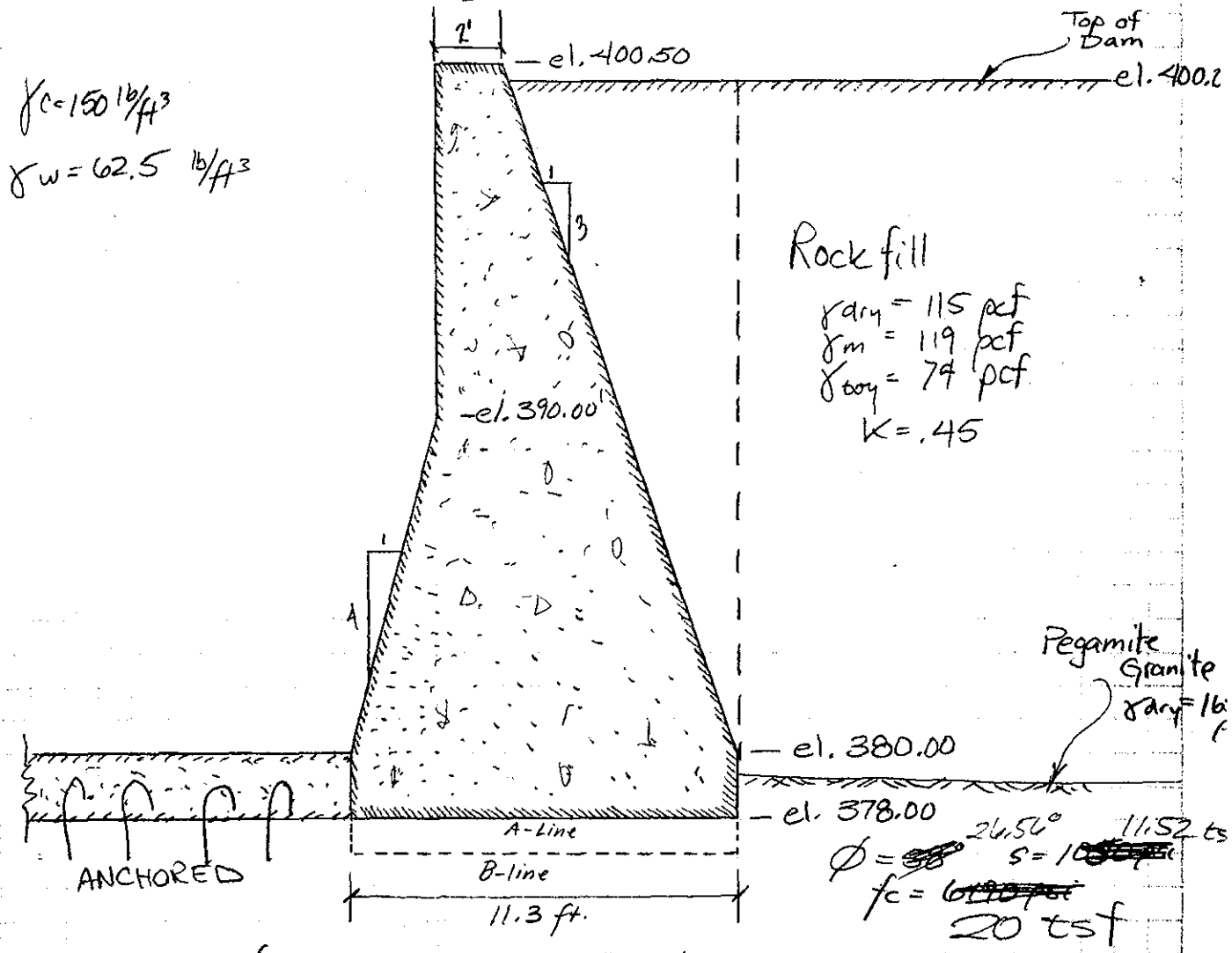
EFFECTIVE BASE = 45.5%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

SUBJECT THOMASTON DAM: INTAKE CHANNEL
COMPUTATION East Retaining Wall Stability Analysis
COMPUTED BY ENestorides CHECKED BY DATE Sept. 9, 1986

Intake Channel: East Retaining Wall Section at station 3+74.00



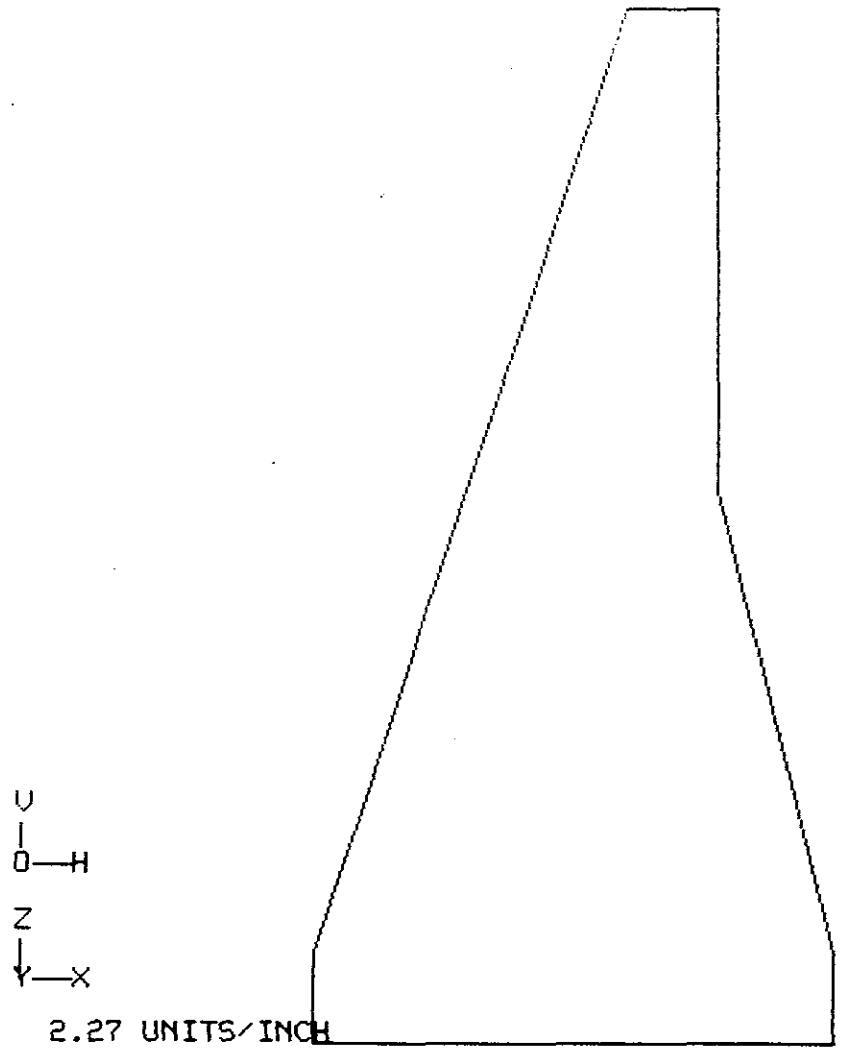
Weight: (2 ft × 20.5 ft × 1 ft) × 150 lb/ft³ ⇒ 6150 lb
Conc.
½ (10 ft × 2.5 ft × 1 ft) × 150 lb/ft³ ⇒ 125 lb.
½ (20.5 ft × 6.83 ft × 1 ft) × 150 lb/ft³ ⇒ 10,501.125 lb
(2 ft × 11.33 ft × 1 ft) × 150 lb/ft³ ⇒ 3399 lb

TOTAL: 20,175.13 lb.

This section was modeled and run on the CDAMS module, of 3DSAD. The filename was TSIEW3A.

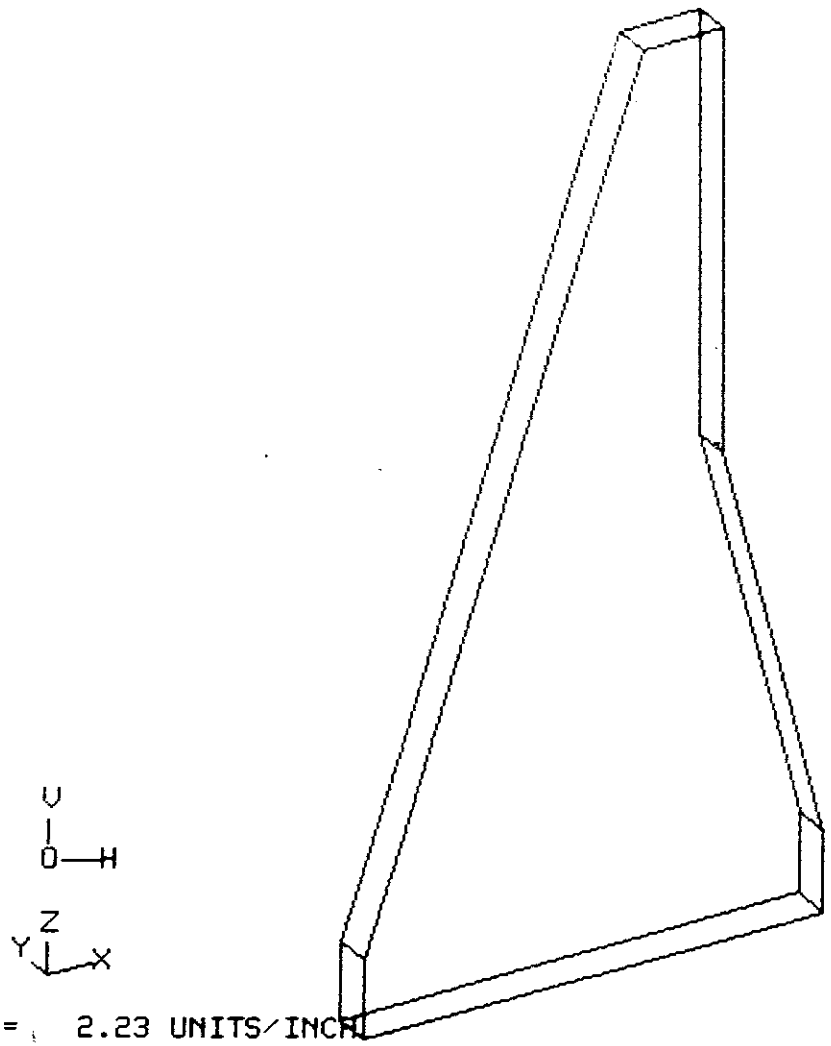
```
10 THOMASTON STABILITY - INTAKE:EAST WALL 3A
20 40000,26.56,23040
30 22
40 115,74,0.45
50 2
60 165,58,0
70 62.5,30,0.1
80 0,0
90 0,0
100 0,0
110 NONOVERFLOW,1,150,0
120 0,0
130 0,0,0,2,0
140 0,6.83,22.5,0.33
150 22.50,0,22.5,0
160 22.5,2,22.5
170 0,22.5,0
180 12.0,2.5,2,0.25
190 0,0,0
200 0,0,0,0,0
210 0,0,0,0,0
220 0,0
/
```

COMMAND ?



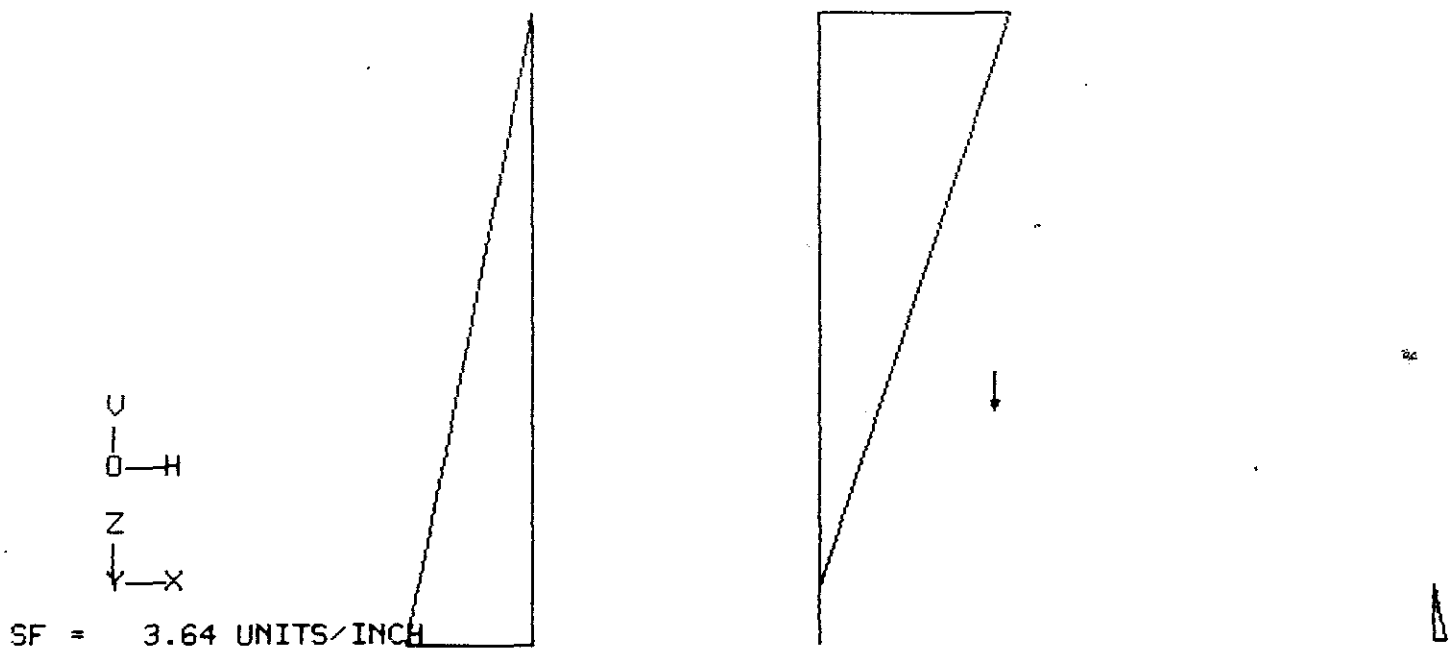
SF = 2.27 UNITS/INCH

COMMAND ?



SF = 2.23 UNITS/INCH

COMMAND ?
?



FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	12523.10 -14697.85	0.00 240243.10	-29395.69 -6261.55

COMMAND ?
?

LOAD CASE I CATEGORY = 1

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	12523.100	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	240243.1	MZ =	-6261.6

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	11.265	0.000	0.000	0.000
C	11.265	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE II
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

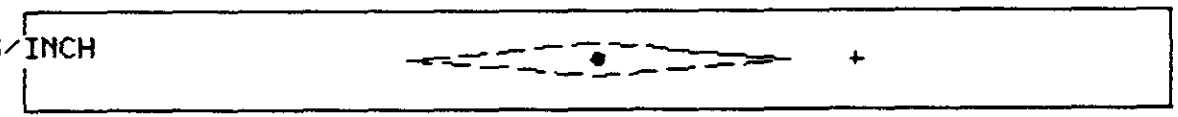
X ECC. = 2.54
Y ECC. = .00

R DIST = -.66

YG
|
ZG—XG

YL
└—XL

SF = 1.03 UNITS/INCH



LOAD CASE I$ CATEGORY = 1

COMPUTED BASE AREA PROPERTIES

AREA =	11.265	IXP =	.9	IYP =	119.1
XBAR =	5.633	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FORCES AND MOMENTS

--INPUT--

FX =	12523.100	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	240243.1	MZ =	-6261.6

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	12523.100	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	240243.1	MZ =	-6261.6

COMPUTED IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	-921.111
B	11.265	0.000	0.000	6140.047
C	11.265	1.000	0.000	6140.052
D	0.000	1.000	0.000	-921.105

COMPUTED SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 21.90

LOAD CASE II
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

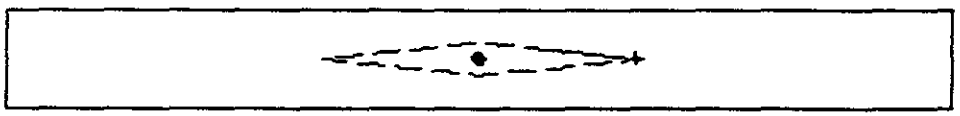
X ECC. = 1.55
Y ECC. = .00

R DIST = -.00

YG
|
ZG—XG

YL
|
└—XL

SF = 1.03 UNITS/INCH



LOAD CASE I CATEGORY = 1

FINAL BASE AREA PROPERTIES

AREA =	9.277	IXP =	.8	IYP =	66.5
XBAR =	6.627	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	12523.100	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	240243.1	MZ =	-6261.6

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	12523.100	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	240243.1	MZ =	-6261.6

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

B-A	1.988	0.000	0.000	-.000
B	11.265	0.000	0.000	6337.459
C	11.265	1.000	0.000	6337.463
C-D	1.988	1.000	0.000	.000

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

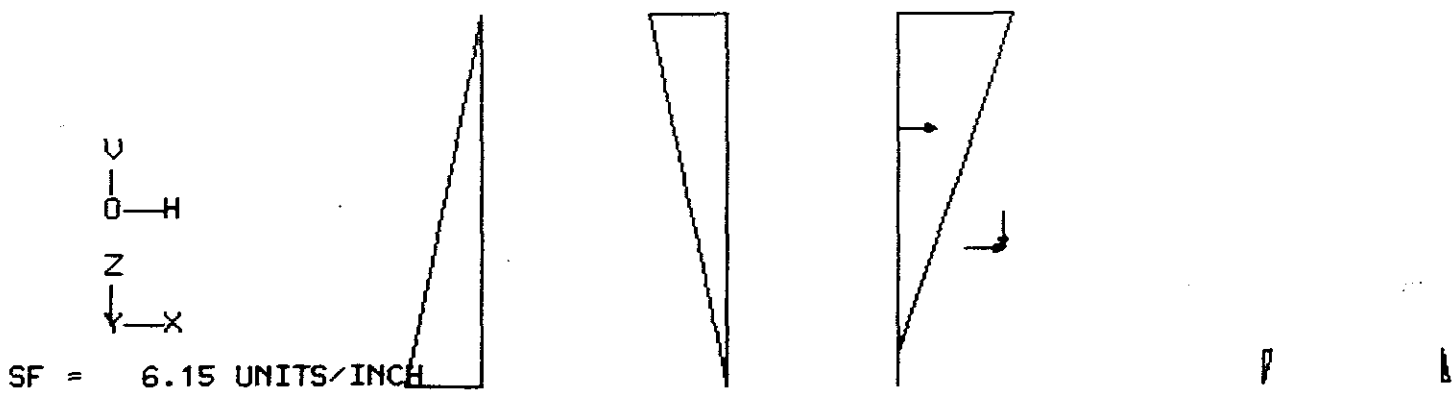
FACTOR OF SAFETY = 18.24

EFFECTIVE BASE = 82.4%

OVERTURNING CRITERIA NOT MET
PEREFF = 82.35% REQUIRED = 100.00%

MAXIMUM BASE PRESSURE CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED

COMMAND ?
?



FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	17967.77 -14697.85	0.00 306672.35	-29395.69 -8983.88

COMMAND ?
?

LOAD CASE VI CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	17967.770	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	306672.4	MZ =	-8983.9

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	11.265	0.000	0.000	0.000
C	11.265	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE [illegible] CATEGORY = 3

COMPUTED BASE AREA PROPERTIES

AREA =	11.265	IXP =	.9	IYP =	119.1
XBAR =	5.633	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FORCES AND MOMENTS

--INPUT--

FX =	17967.770	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	306672.4	MZ =	-8983.9

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	17967.770	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	306672.4	MZ =	-8983.9

COMPUTED IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	-4061.968
B	11.265	0.000	0.000	9280.904
C	11.265	1.000	0.000	9280.910
D	0.000	1.000	0.000	-4061.963

COMPUTED SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 15.26

LOAD CASE VI
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = .42
Y ECC. = .00

R DIST = -.00

```
YG
|
ZG—XG

YL
└—XL
```

SF = 1.03 UNITS/INCH

LOAD CASE 1 CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	2.497	IXP =	.2	IYP =	1.3
XBAR =	10.016	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	17967.770	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	306672.4	MZ =	-8983.9

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	17967.770	FY =	0.000	FZ =	-29395.690
MX =	-14697.9	MY =	306672.4	MZ =	-8983.9

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

B-A	8.768	0.000	0.000	.000
B	11.265	0.000	0.000	23541.829
C	11.265	1.000	0.000	23541.845
C-D	8.768	1.000	0.000	-.000

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 4.02

EFFECTIVE BASE = 22.2%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT THOMASTON STABILITY – EAST OUTLET WALL
COMPUTATION Computer Runs SUMMARY SHEET
COMPUTED BY E Nestorides CHECKED BY DATE Sept. 16, 1986

TSDEW 1 & 2:

Section and Criteria Description	(Load Case I EM 1110-2-2400) Load Case 2	(Load Case Ia) Load Case 6
Section 1		
final Shear F.O.S.	28.2	45.6
Effective Base	100%	100%
Overturning Criteria	OK	OK
Max. Base Pressure Criteria	OK	OK
Sliding Criteria	OK	OK
Stability achieved?	– Yes –	– Yes –
Section 2		
final Shear F.O.S.	41.3	23.9
Effective Base	100%	89.6%
Overturning Criteria	OK	OK
Max. Base Pressure Criteria	OK	OK
Sliding Criteria	OK	OK
Stability Achieved?	– Yes –	– YES –

These computer runs involved No water Loading, since Rock fill is free draining.

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT THOMASTON DAM STABILTY REVIEW
COMPUTATION Sample CDAMS Input File
COMPUTED BY ENestorides CHECKED BY DATE 9-26-86

CDAMS INPUT FILE

10 TITLE
20 Allowable bearing, ϕ angle, shear strength
30 Elevation of upstream soil layer
40 γdry, γbuoyant, K (upstream layer)
50 Elevation of downstream soil layer
60 γdry, γbuoyant, K (downstream layer)
70 γwater, wind pressure, seismic coefficient
80 Normal headwater elevation, Tailwater elevation
90 Induced headwater elevation, Tailwater elevation
100 Flood headwater elevation, Tailwater elevation
110 Type of Section, Depth, Unit Weight, No. of Gallories
120 X drain, % effective
130 X_5, ELHEEL, X_{502}, EL50, SLP51
140 HEEL, X504, ELBK, USLP
150 EL52, X505, EL53, SLP53
160 EL54, X506, EL55
170 X507, EL56, SLP54
180 EL57, EL56, SL54
190 Toe, EL toe, BSLP
200 Anchor Load, xanchor, yanchor, ELanchor
210 Misc Load, x misc, y misc, EL misc.
220 Ice load, Thickness

See Geometric Figure below

The above file was used for the following sections.

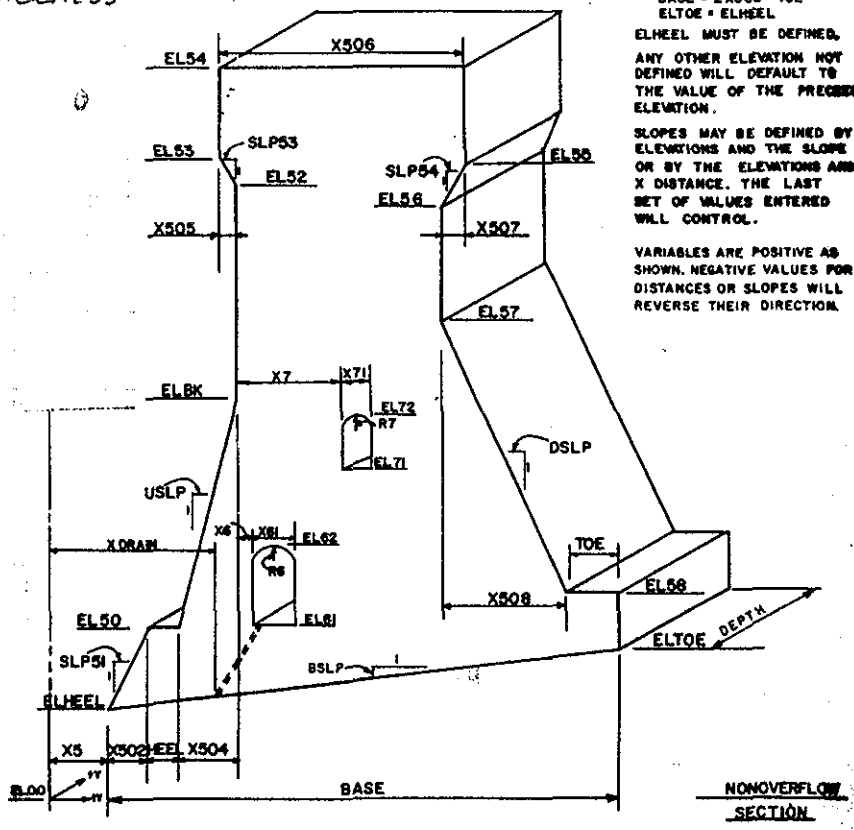
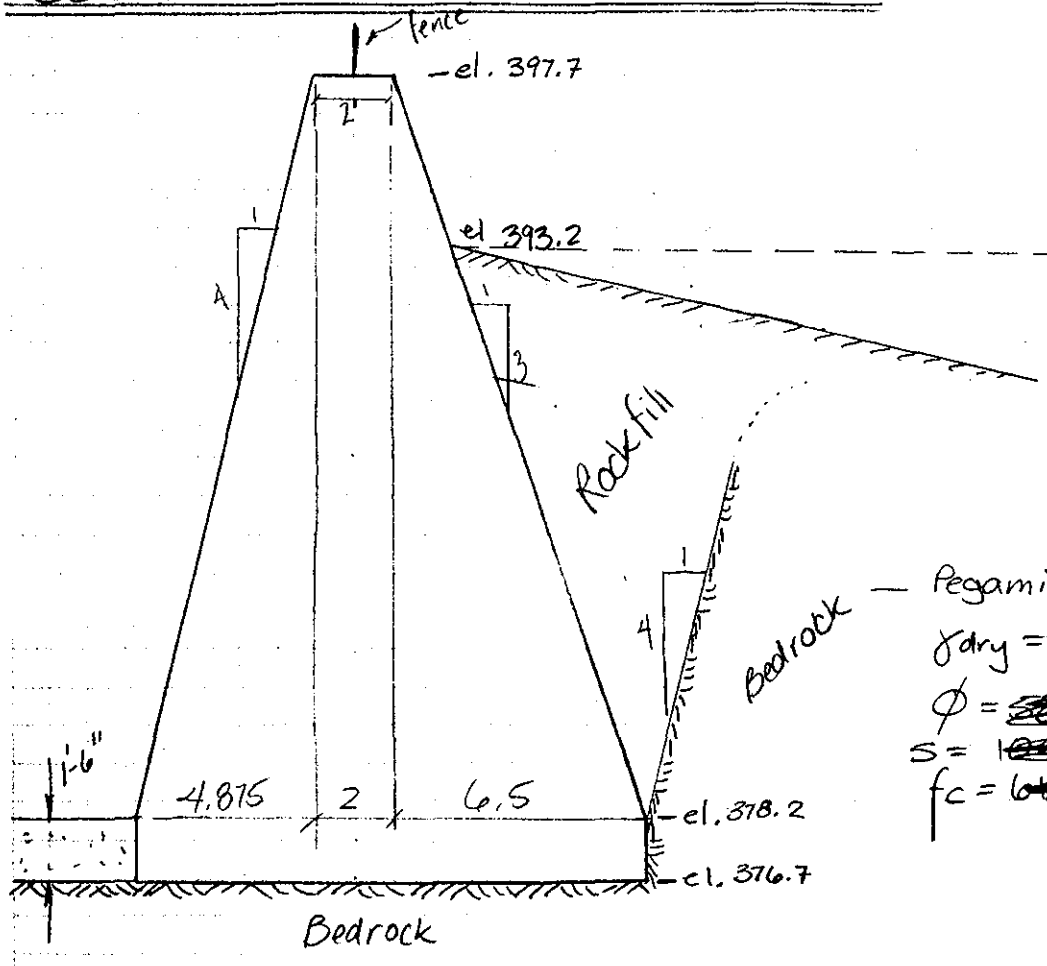


Figure 6. Nonoverflow monolith

SUBJECT THOMASTON STABILITY : Outlet Works
COMPUTATION Outlet Channel East Retaining Wall
COMPUTED BY E Nestorides CHECKED BY DATE Sept. 16, 1986

Consider section — at sta. 8 + 68



— Pegamite granite
$\gamma_{dry} = 165$ pcf
$\phi =$ ~~38°~~ 26.56°
$S =$ ~~1040 psf~~ 11,52
$f_c =$ ~~6000 psi~~ 20 T/sf

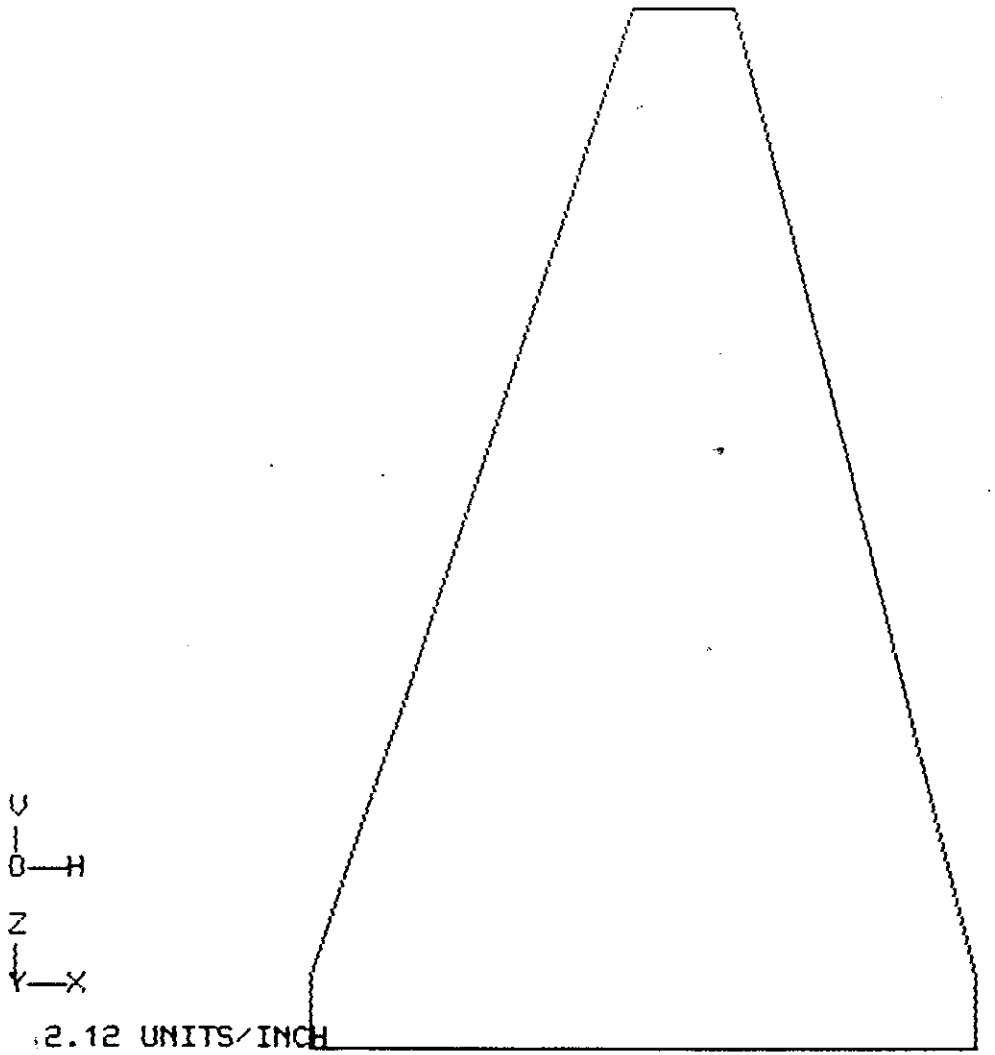
$\gamma_c = 150$ lb/ft³

Rockfill ⇒ $\gamma_{dry} = 115$ pcf $K = .45$
$\gamma_{moist} = 119$ pcf
$\gamma_{boy} = 74$ pcf

This section was modeled and run on the CDAMS module of 3DSAD. The filename was TSOEW1.

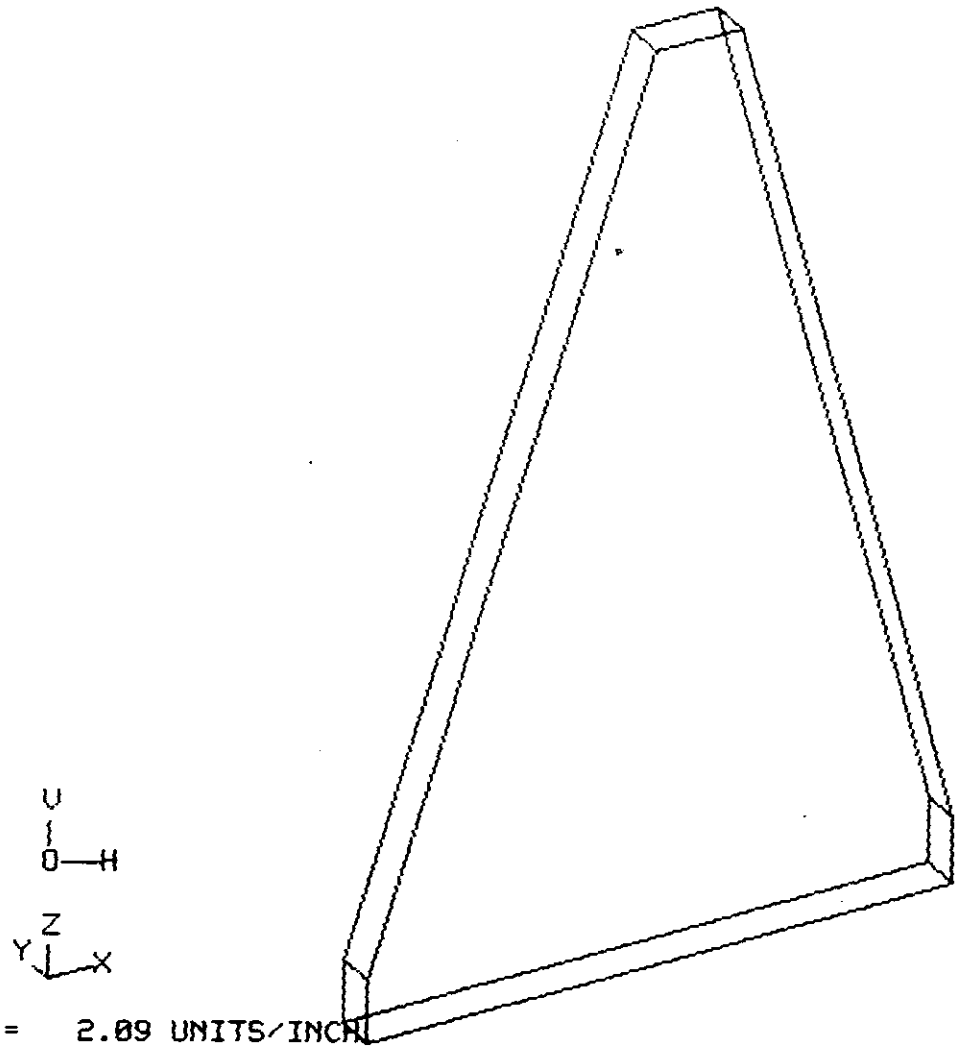
```
10 THOMASTON STABILITY - OUTLET EAST WALL:1
20 40000,26.56,23040
30 16.5
40 115,74,0.45
50 1.5
60 165,58,0
70 62.5,30,0.1
80 0,0
90 0,0
100 0,0
110 NONOVERFLOW,1,150,0
120 0,0
130 0,0,0,1.5,0
140 0,6.5,21,0.33
150 21,0,21,0
160 21,2,21
170 0,21,0
180 21,4.875,1.5,0.25
190 0,0,0
200 0,0,0,0
210 0,0,0,0
220 0,0
/
```

COMMAND ?
?



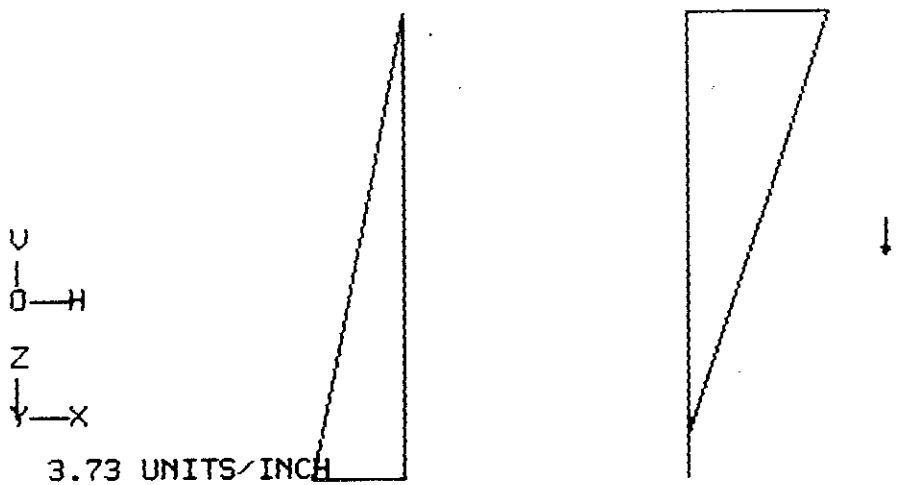
SF = 2.12 UNITS/INCH

COMMAND ?
?



SF = 2.09 UNITS/INCH

COMMAND ?
?



SF = 3.73 UNITS/INCH

FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	7044.24 -14827.50	0.00 221203.64	-29655.01 -3522.12

COMMAND ?
?

LOAD CASE I CATEGORY = 1

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	7044.240	FY =	0.000	FZ =	-29655.010
MX =	-14827.5	MY =	221203.6	MZ =	-3522.1

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	13.310	0.000	0.000	0.000
C	13.310	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE I1
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

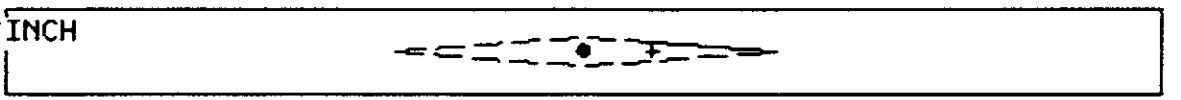
X ECC. = .80
Y ECC. = -.00

R DIST = .11

YG
|
ZG—XG

YL
|
└—XL

SF = 1.22 UNITS/INCH



LOAD CASE I3 CATEGORY = 1

FINAL BASE AREA PROPERTIES

AREA =	13.310	IXP =	1.1	IYP =	196.5
XBAR =	6.655	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	7044.240	FY =	0.000	FZ =	-29655.010
MX =	-14827.5	MY =	221203.6	MZ =	-3522.1

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	7044.240	FY =	0.000	FZ =	-29655.010
MX =	-14827.5	MY =	221203.6	MZ =	-3522.1

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	50.739
B	13.310	0.000	0.000	4405.315
C	13.310	1.000	0.000	4405.311
D	0.000	1.000	0.000	50.734

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

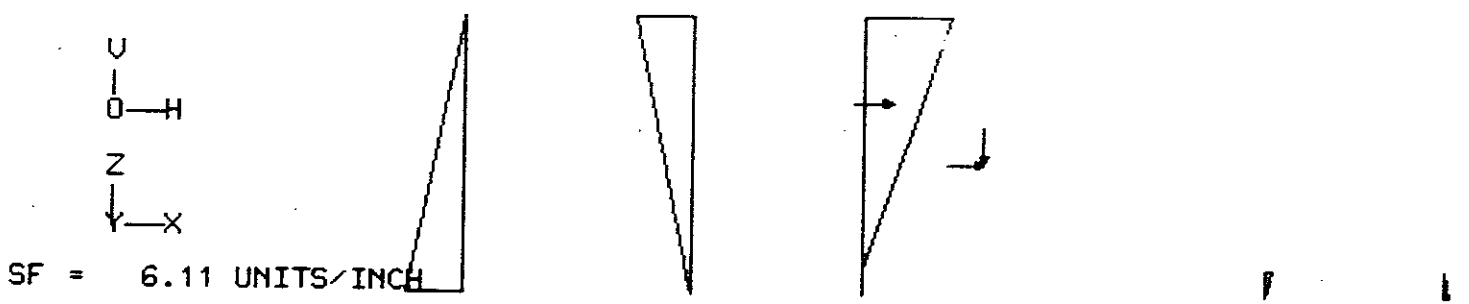
FACTOR OF SAFETY = 28.16

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

COMMAND ?
?



FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	11418.86 -14827.50	0.00 261640.74	-29655.01 -5709.43

COMMAND ?
?

LOAD CASE ~~0~~IA CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	11418.860	FY =	0.000	FZ =	-29655.010
MX =	-14827.5	MY =	261640.7	MZ =	-5709.4

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	13.310	0.000	0.000	0.000
C	13.310	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE ØI^
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

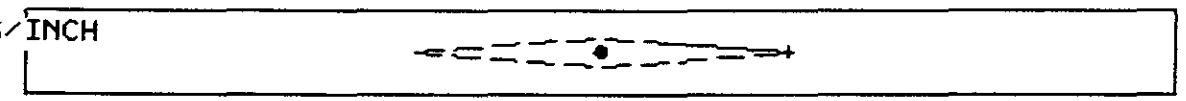
X ECC. = 2.17
Y ECC. = -.00

R DIST = -.00

YG
|
ZG—XG

YL
|
└—XL

SF = 1.22 UNITS/INCH



LOAD CASE Ia CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	13.310	IXP =	1.1	IYP =	196.5
XBAR =	6.655	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	11418.860	FY =	0.000	FZ =	-29655.010
MX =	-14827.5	MY =	261640.7	MZ =	-5709.4

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	11418.860	FY =	0.000	FZ =	-29655.010
MX =	-14827.5	MY =	261640.7	MZ =	-5709.4

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	1420.280
B	13.310	0.000	0.000	3035.774
C	13.310	1.000	0.000	3035.769
D	0.000	1.000	0.000	1420.276

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 45.64

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED

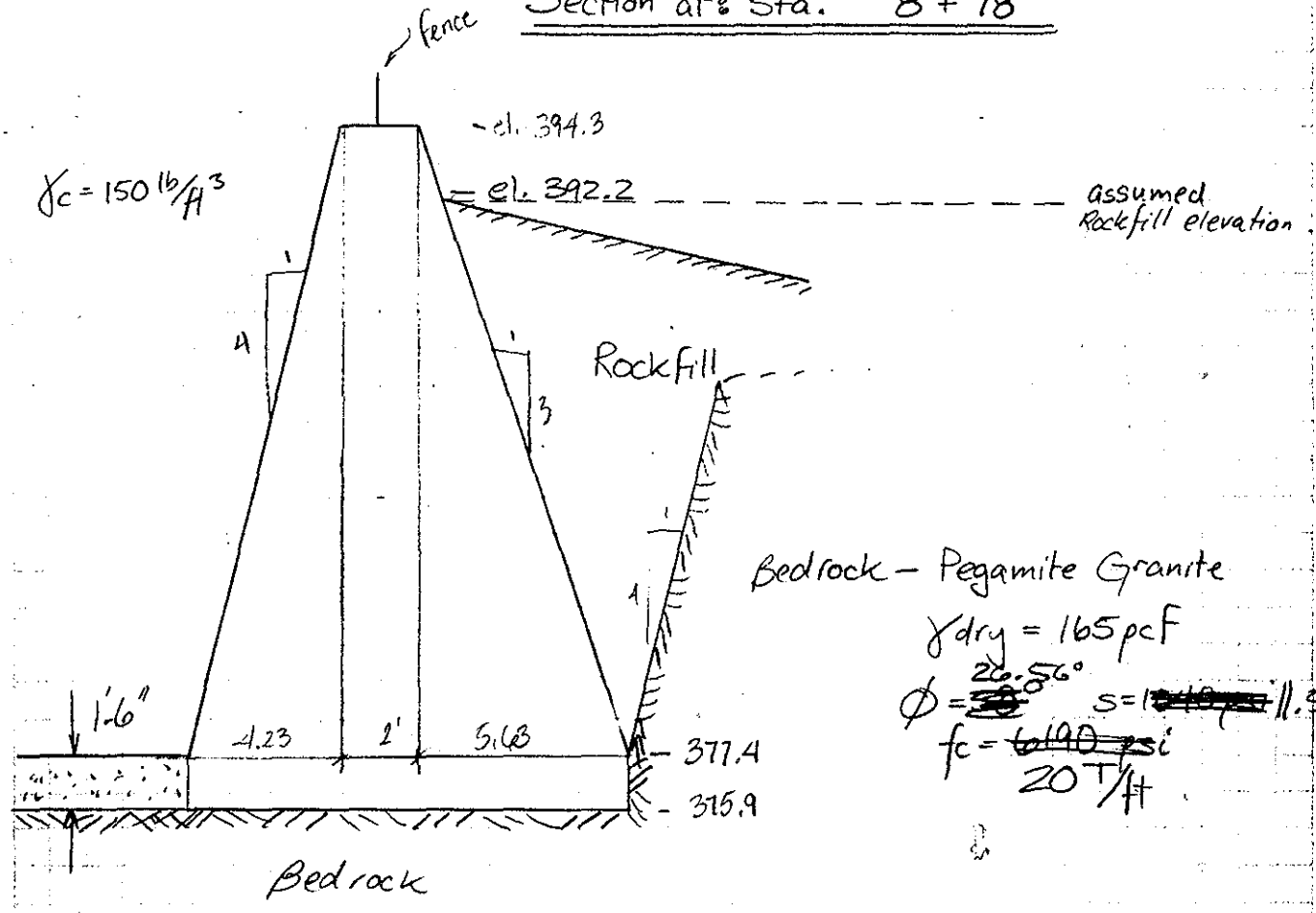
STABILITY ACHIEVED FOR THIS LOAD CASE

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT THOMASTON - STABILITY : OUTLET WORKS
COMPUTATION Outlet Channel East Retaining Wall
COMPUTED BY ENestorides CHECKED BY J DATE 9-16-86

Section at: sta. 8 + 78



Bedrock – Pegamite Granite
$\gamma_{dry} = 165\ pcf$
$\phi = 26.56°$ $s = 11.52$
$f_c = 20\ T/ft$

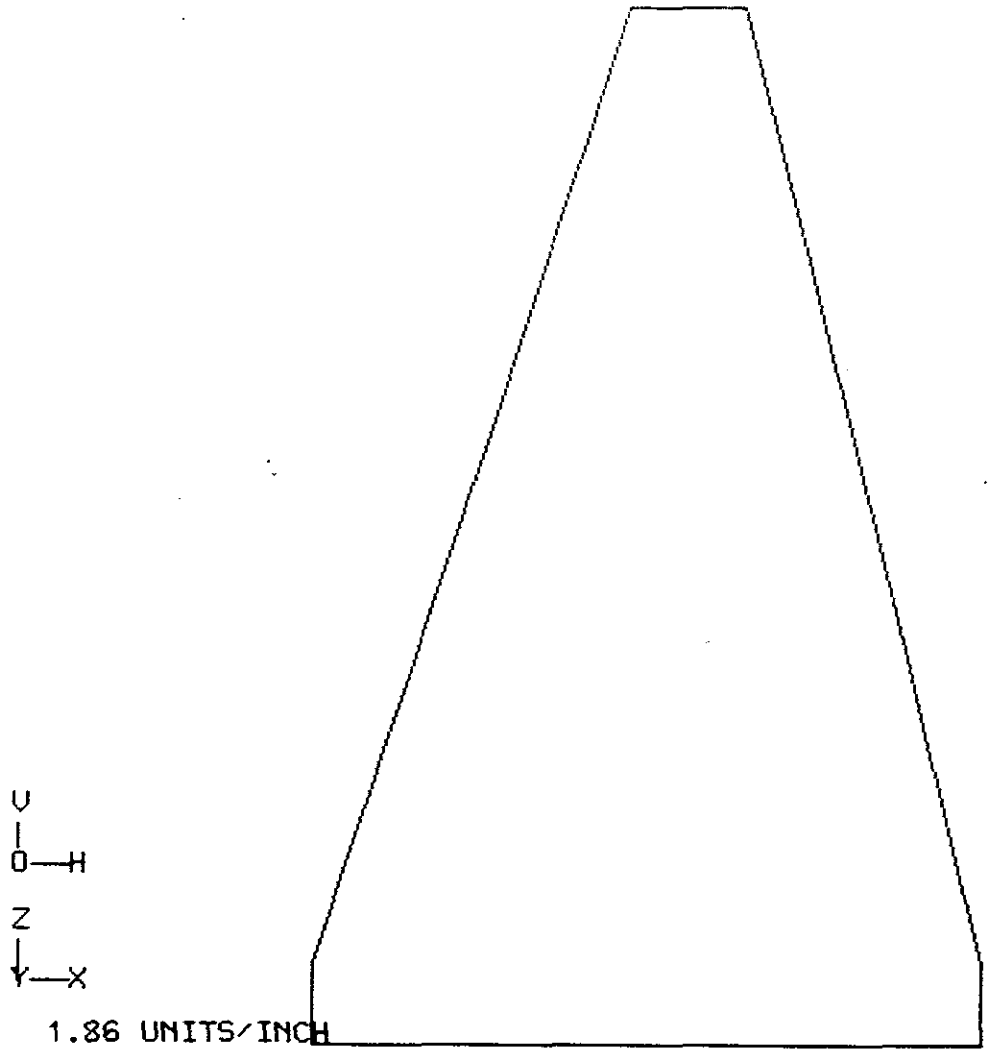
Rockfill ⇒ $\gamma_{dry} = 115\ pcf$
$\gamma_{moist} = 119\ pcf$
$\gamma_{boy} = 74\ pcf$

$K = .45$

This section was modeled and run on the CDAMS module of 3DSAD. The file name was TSOEW2.

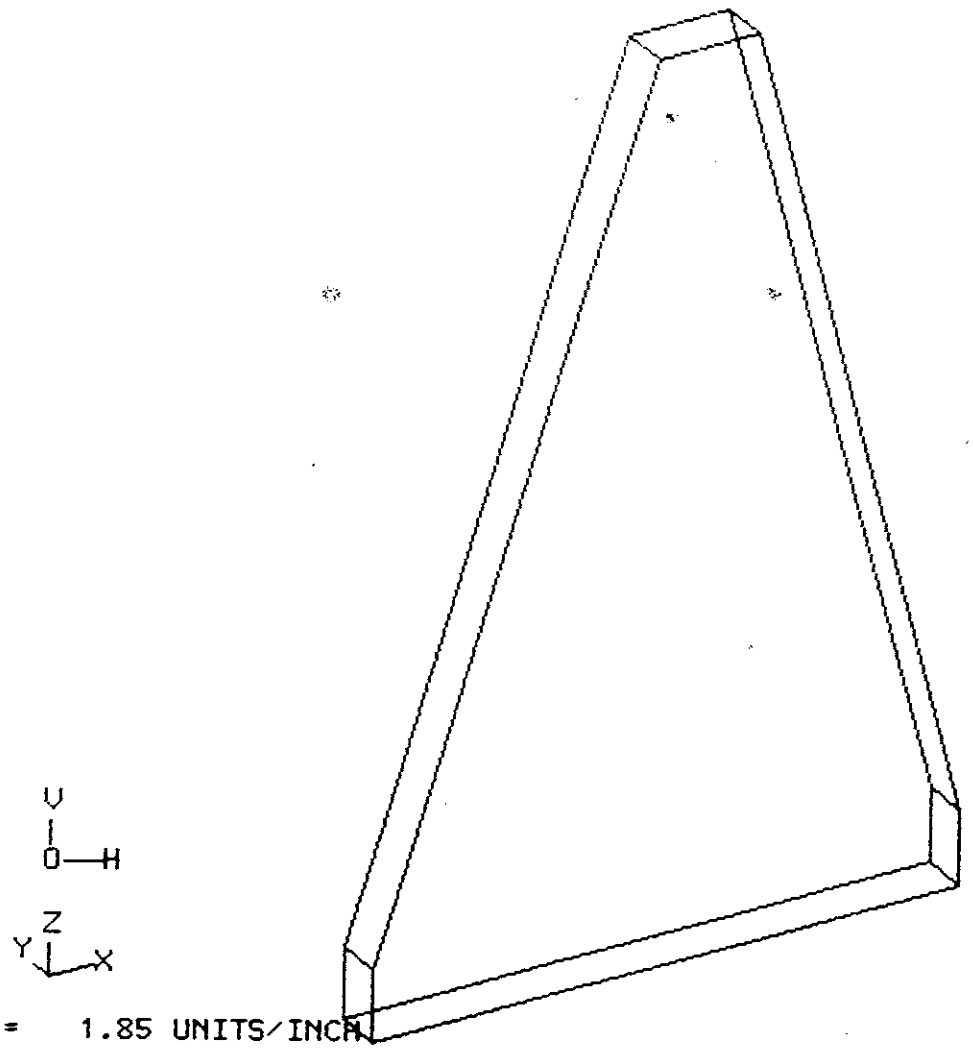
```
10 THOMASTON STABILITY - OUTLET EAST WALL:2
20 40000,26.56,23040
30 16.3
40 115,74,0.45
50 1.5
60 165,58,0
70 62.5,30,0.1
80 0,0
90 0,0
100 0,0
110 NONOVERFLOW,1,150,0
120 0,0
130 0,0,0,1.5,0
140 0,5.63,18.4,0.33
150 18.4,0,18.4,0
160 18.4,2,18.4
170 0,18.4,0
180 18.4,4.23,1.5,0.25
190 0,0,0
200 0,0,0,0
210 0,0,0,0
220 0,0
/
```

COMMAND ?
?



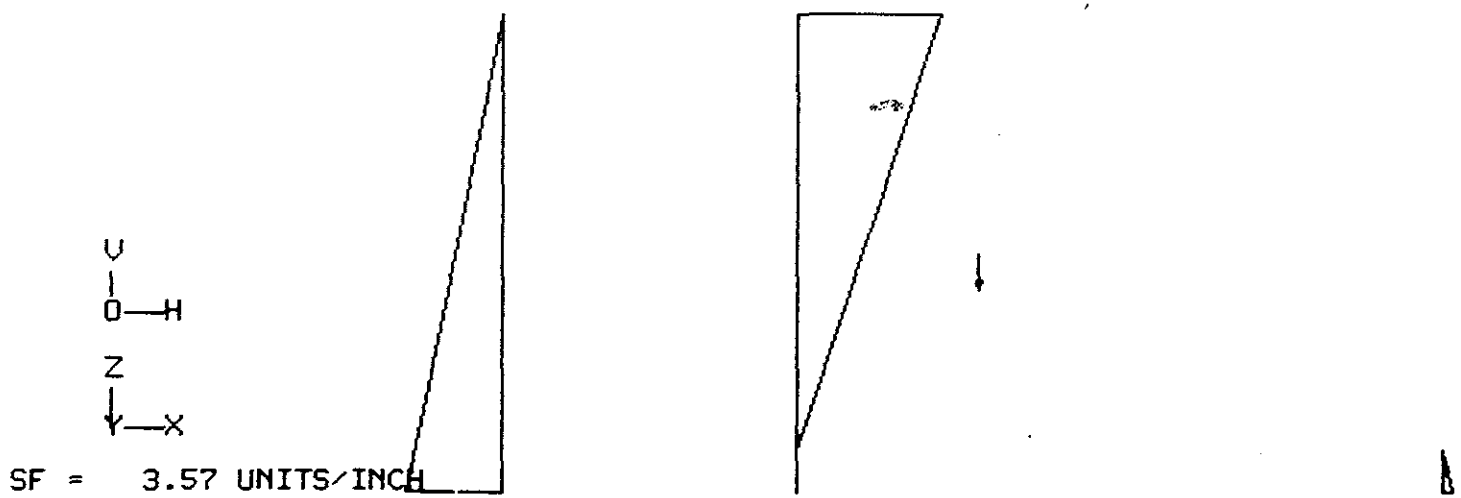
SF = 1.86 UNITS/INCH

COMMAND ?
?



SF = 1.85 UNITS/INCH

COMMAND ?
?



FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	6874.50 -12152.89	0.00 167433.89	-24305.77 -3437.25

COMMAND ?
?

LOAD CASE I4 CATEGORY = 1

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	6874.500	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	167433.9	MZ =	-3437.3

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	11.802	0.000	0.000	0.000
C	11.802	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE I4
CATEGORY = 1

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

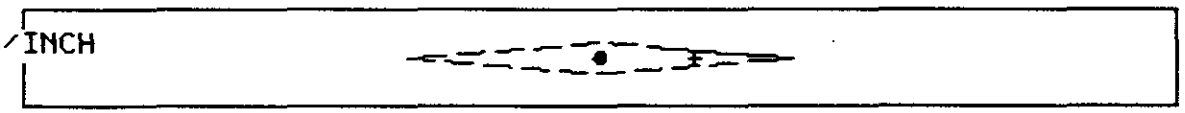
X ECC. = .99
Y ECC. = .00

R DIST = .08

YG
|
ZG—XG

YL
|
└—XL

SF = 1.08 UNITS/INCH



LOAD CASE I1 CATEGORY = 1

FINAL BASE AREA PROPERTIES

AREA =	11.802	IXP =	1.0	IYP =	137.0
XBAR =	5.901	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	6874.500	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	167433.9	MZ =	-3437.3

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	6874.500	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	167433.9	MZ =	-3437.3

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	1025.386
B	11.802	0.000	0.000	3093.533
C	11.802	1.000	0.000	3093.538
D	0.000	1.000	0.000	1025.391

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

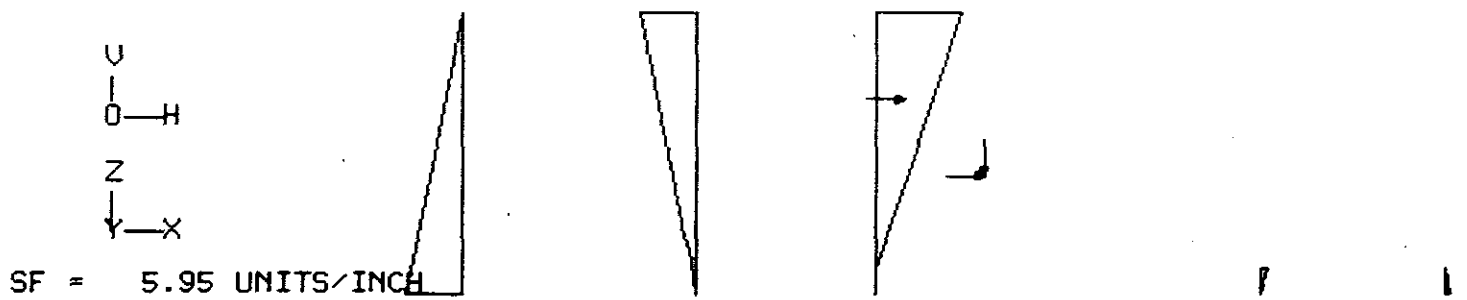
FACTOR OF SAFETY = 41.33

EFFECTIVE BASE = 100.0%

OVERTURNING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

COMMAND ?
?



FORCE

NAME	FX MX	FY MY	FZ MZ
TOTAL	10680.25 -12152.89	0.00 201204.14	-24305.77 -5340.13

COMMAND ?
?

LOAD CASE 4Ia CATEGORY = 3

INPUT FORCES AND MOMENTS EXCLUDING UPLIFT

FX =	10680.250	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	201204.1	MZ =	-5340.1

INPUT COORDINATES AND UPLIFT VALUES

NAME	X	Y	Z	UPLIFT
A	0.000	0.000	0.000	0.000
B	11.802	0.000	0.000	0.000
C	11.802	1.000	0.000	0.000
D	0.000	1.000	0.000	0.000

PHI = 26.60 SHRSTR = 23040.00 SANGLE = DEFAULT

DENSITY = .0625

LOAD CASE ~~Ø~~Ia
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

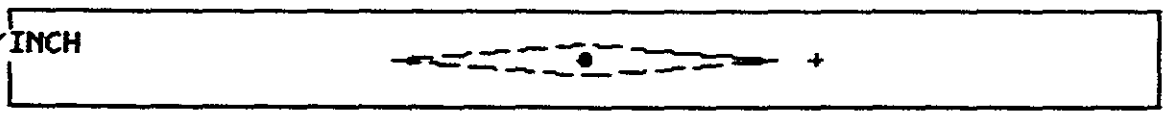
X ECC. = 2.38
Y ECC. = .00

R DIST = -.41

YG
ZG—XG

YL
XL

SF = 1.08 UNITS/INCH



LOAD CASE ~~4~~Ia CATEGORY = 3

COMPUTED BASE AREA PROPERTIES

AREA =	11.802	IXP =	1.0	IYP =	137.0
XBAR =	5.901	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FORCES AND MOMENTS

--INPUT--

FX =	10680.250	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	201204.1	MZ =	-5340.1

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	10680.250	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	201204.1	MZ =	-5340.1

COMPUTED IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

A	0.000	0.000	0.000	-429.317
B	11.802	0.000	0.000	4548.236
C	11.802	1.000	0.000	4548.241
D	0.000	1.000	0.000	-429.312

COMPUTED SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 26.60

LOAD CASE ØIa
CATEGORY = 3

ECCENTRICITY
IN LOCAL
COORDINATE SYSTEM

X ECC. = 1.76
Y ECC. = .00

R DIST = -.00

YG
|
ZG—XG

YL
|
└—XL

SF = 1.08 UNITS/INCH

LOAD CASE ØI< CATEGORY = 3

FINAL BASE AREA PROPERTIES

AREA =	10.572	IXP =	.9	IYP =	98.5
XBAR =	6.516	YBAR =	.500	ZBAR =	0.000
XYANG =	0.000	ZNANG =	0.000	PXANG =	0.000

SUMMARY OF FINAL FORCES AND MOMENTS

--INPUT--

FX =	10680.250	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	201204.1	MZ =	-5340.1

--COMPUTED UPLIFT--

FX =	0.000	FY =	0.000	FZ =	0.000
MX =	0.0	MY =	0.0	MZ =	0.0

--TOTAL--

FX =	10680.250	FY =	0.000	FZ =	-24305.770
MX =	-12152.9	MY =	201204.1	MZ =	-5340.1

FINAL IN PLANE COORDINATES AND BASE PRESSURES

NAME	X	Y	Z	PRESSURE

B-A	1.230	0.000	0.000	-.000
B	11.802	0.000	0.000	4598.191
C	11.802	1.000	0.000	4598.195
C-D	1.230	1.000	0.000	.000

FINAL SHEAR FRICTION FACTOR OF SAFETY

PHI = 26.60 SHRSTR = 23040.00 SANGLE = 0.00

FACTOR OF SAFETY = 23.95

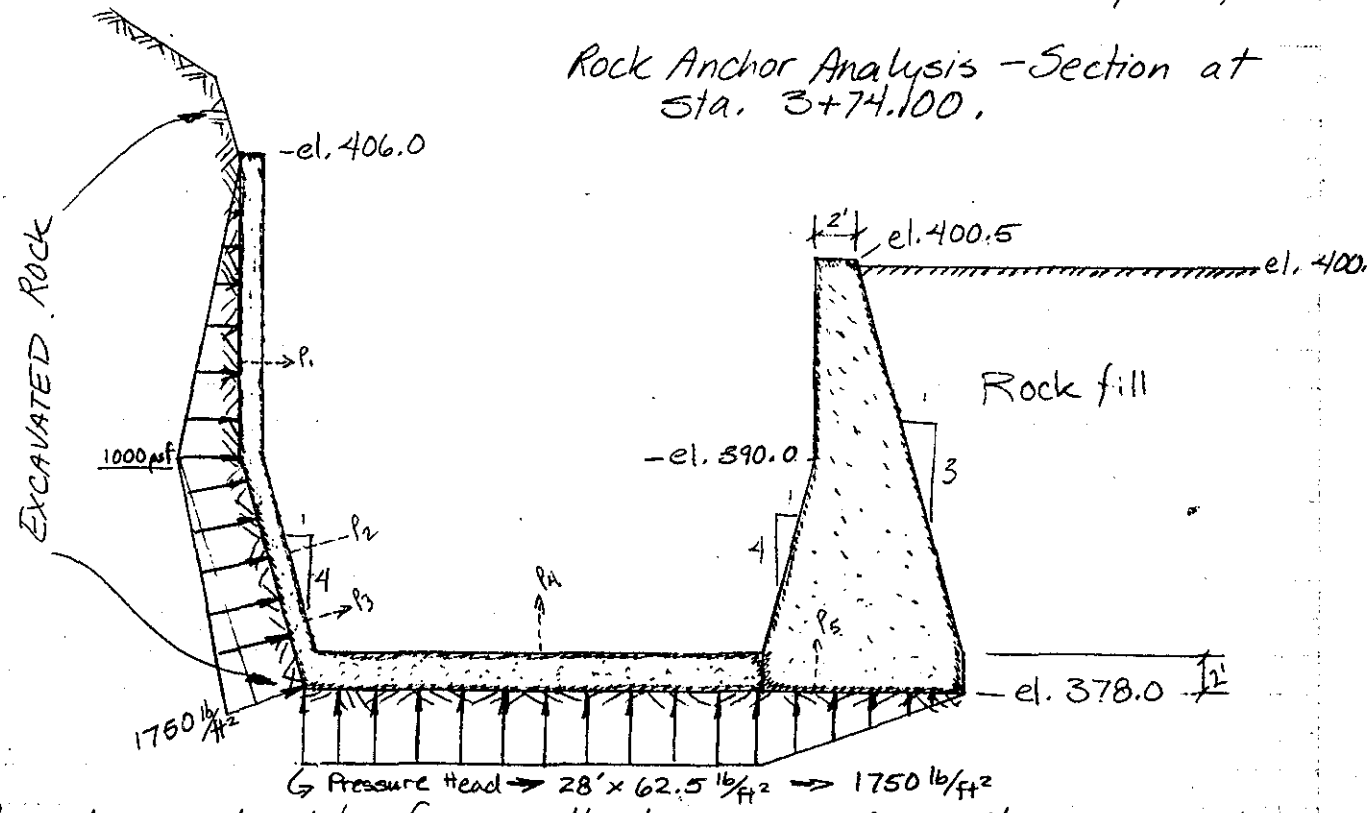
EFFECTIVE BASE = 89.6%

OVERTURNING CRITERIA SATISFIED
SLIDING CRITERIA SATISFIED
MAXIMUM BASE PRESSURE CRITERIA SATISFIED

STABILITY ACHIEVED FOR THIS LOAD CASE

SUBJECT Thomaston Stability - Wisk Intake Channel Wall
COMPUTATION Rock anchors: structural adequacy computations.
COMPUTED BY E Nestorides CHECKED BY DATE Sept. 16, 1986

Rock Anchor Analysis - Section at Sta. 3+74.100.



Consider hydrostatic forces all along the left wall and base slab, however due to the free-draining rock fill behind the gravity wall, uplift pressures go to zero.

Uplift Pressure forces: Resultants

$P_1 \Rightarrow \frac{1}{2}(62.5 \times 16')16' = 8000$ lb/ft
$P_2 \Rightarrow (7.215' \times 1000 \text{ lb/ft}^2) = 7215$ lb/ft.
$P_3 \Rightarrow \frac{1}{2}(62.5 \times 12)(7.215) = 2706$ lb/ft
$P_4 \Rightarrow (24' \times 1750 \text{ lb/ft}^2) = 42{,}000$ lb/ft
$P_5 \Rightarrow \frac{1}{2}(1750 \text{ lb/ft}^2)(11.3 \text{ ft}) \Rightarrow 9{,}888$ lb/ft

Current Anchors:

#11 bars grouted 3½" holes 6'-0 deep

1. Base Slab. ⇒ 1 foot strip.

Load/sq.ft ⇒ 1750 lb/ft² Length = 24 ft. Slab Depth = 2 ft.

$f_c' = 3000$ psi $f_y = 18{,}000$ psi consider #11 bars $A_b = 1.56$ in²

Load allowable/bar ⇒ 18,000/1.56 ⇒ 11,538.5 lb

1 ft strip { anchor spacing ⇒ $\frac{11{,}538.5 \text{ lb}}{1750 \text{ lb/ft}}$ ⇒ 6.6 ft. o.c. each way.

Anchors currently at 4.0' o.c. ⇒ OK ✓

SUBJECT THOMASTON STABILITY : West Intake Channel Wall
COMPUTATION Rock Anchors : structural adequacy computations
COMPUTED BY E Nestorides CHECKED BY DATE Sept. 16, 1986

2. Rock Anchor depth:

Based on EM 1110-1-2907:

The typical ultimate bond stresses between the anchor-grout plug and granite is 250 psi - 450 psi.

Consider worse case 250 psi.

3½" holes ⇒ surface area (1" cylinder) ⇒ 11" × 1" ⇒ 11 in²

250 lb/in² × 11 in² ⇒ 2750 lb per in of anchor plug.

Load per anchor / Load per in of plug ⇒ 11538.5 lb / 2750 lb. ⇒ 4.2" min.

Based on design memorandum #7 p.A15: #11 bar perimeter = 4.43 in

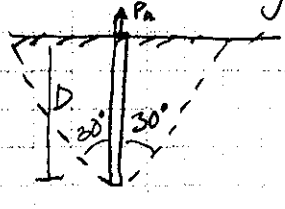
allowable bond stress between anchor + grout ⇒ 300 psi

300 lb/in² × 4.43 in² ⇒ 1329 lb per in of anchor.

11538.5 lb/anchor / 1329 lb per in anchor ⇒ 8.7" say 9"

Therefore a minimum embedded length in concrete ⇒ 9"
in sound rock ⇒ 18" *
* double for safety.

→ Cone of rock providing anchorage ←
based on Navy DM-7 March 1971



P_a = 11,538.5 lb
C_{all} ⇒ allowable shear stress ⇒ 1050 psi
f_y = 18,000 psi

Controls

$P_A = (2.1)(C_{all})(D^2)$ ⇒ $D = \sqrt{\frac{P_A}{2.1(C_{all})}} = \sqrt{\frac{11,538.5^{\#}}{2.1(1050)^{\#}/in^2}}$

$D = \underline{2.29''}$

Min. $D_{ft.}$ ⇒ $1.25\sqrt{P_A \text{ (kips)}}$

Therefore, $D \Rightarrow 1.25\sqrt{11.5385}$

$D = \underline{\underline{4.25 \text{ ft.}}}$ min.

Anchors presently at a depth of 6'-0" — OK!

3. Anchored Wall:

Current anchorage of this wall is the same as for the base slab, starting at 4' o.c. spacing at the base and moving to 8' o.c. at top [Horizontally]

Vertical spacing of the anchors remains at 4' o.c. throught the length of the wall.

Given that the base slab anchorage was judged more than adequate in parts 1 & 2 of these computations, present wall anchorage is also found adequate.

4. The Outlet Channel West Wall:

The west wall of the outlet is a similarly anchored wall. Given that the original anchorage design for the intake west wall surpassed present design requirements, and given that the scheme is the same for the outlet wall, we feel it is not necessary to do further calculations in review its stability.

SUBJECT THOMASTON STABILITY REVIEW
COMPUTATION SERVICE BRIDGE ABUTMENT
COMPUTED BY E Nestorides CHECKED BY DATE 9-23-86

SUMMARY SHEET.

	Overturning	Sliding	Base Pressure	
Load Case 1 No water	OK	OK	NO	
Load Case 2 el. 494 water behind	OK	OK	NO	
Load Case 3 el. 512 water behind el 494 " infront.	(– NO –)	(– NO –)	(NO.)	Not Considered see p. 5a
Earthquake Loading (LC1)	OK	OK	No	

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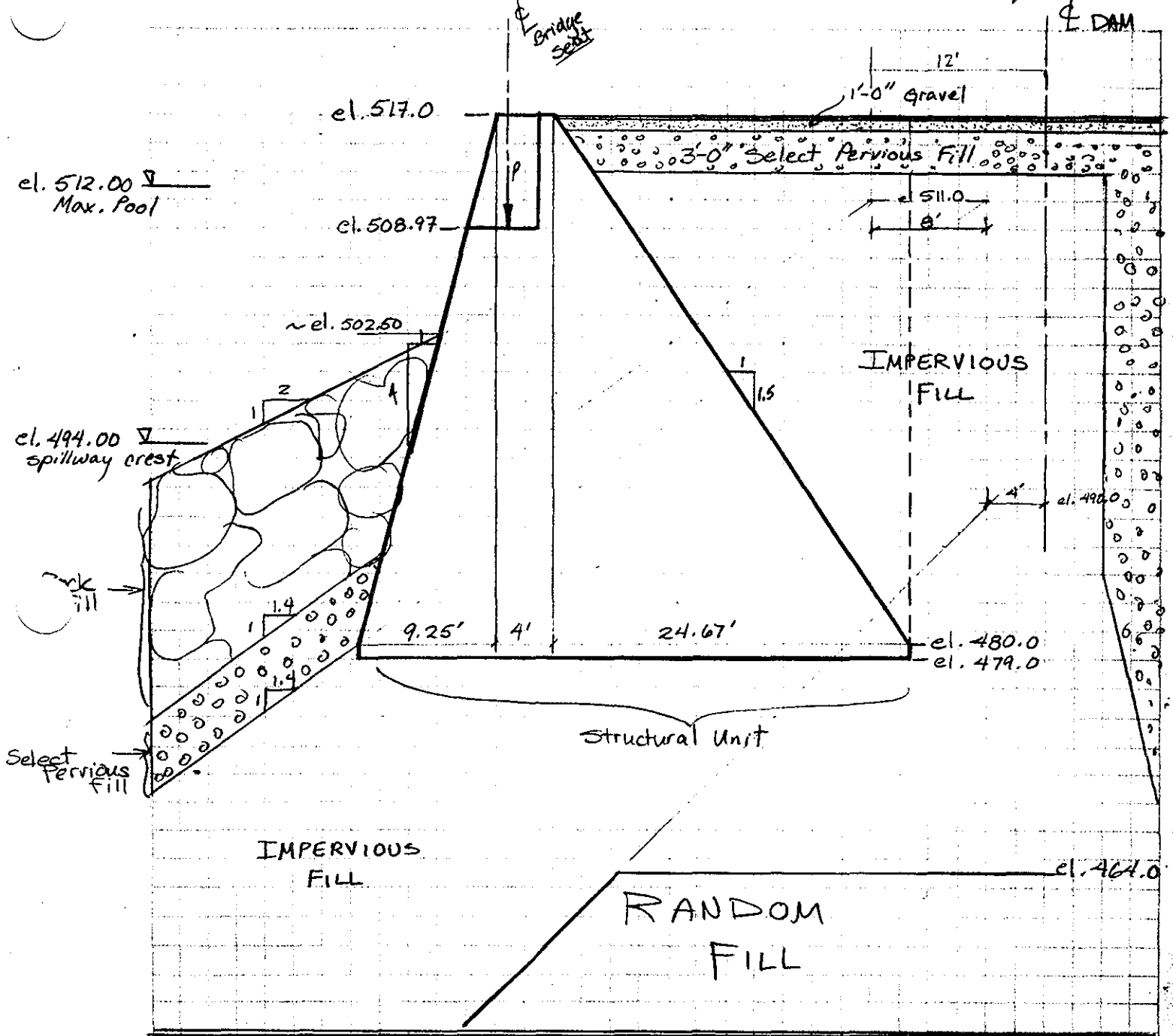
SUBJECT THOMASTON STABILITY REVIEW
COMPUTATION Service Bridge Abutment
COMPUTED BY E Nestorides CHECKED BY DATE 9/18/86



P ⇒ original comps. 9.9 k/' ⇒ 3.9 k/' live, 6.0 k/' dead.
However, since original design involved a 2 span bridge this figure is no longer valid.

[attached] #7 [A-6A] The calculated dead load of the "as-built" bridge is ⇒ 351,680 lbs.
The Live Load as calculated for the "as-built" bridge is ⇒ 146,800 lbs.
498,480 lbs.

or 249.24 kips / support

Given 12 feet of bridge seating ⇒ $\frac{249.24}{12}$ ⇒ 20.77 k/ft = P

SUBJECT THOMASTON STABILITY REVIEW
COMPUTATION SERVICE BRIDGE ABUTMENT
COMPUTED BY E Nestorides CHECKED BY DATE 9/18/86

1. Weight of One-foot Structural Section

$V_{C_1} = \frac{1}{2}[9.25 \times 37] \times 1ft \Rightarrow 171.125 - \frac{1}{2}(2ft \times 8.03) \times 1ft) = 163.095$

$V_{C_2} = \frac{1}{2}[24.67 \times 37] \times 1ft \Rightarrow 456.395$

$V_{C_3} = [(4 \times 37) - (3ft \times 8.03)] \times 1ft = 123.91$ Volume = 781.32 ft^3

$V_{C_4} = [1 ft \times 37.92] \times 1ft = 37.92$ $W_C = \frac{781.32 ft^3 \times 150 lb/ft^3}{1000 lb/kip} \Rightarrow \underline{117.2}$

Weight of soil resting on structure } ⇒ Volume 456.395 ft^3

ASSUMING

CASE: ① No water $W_S = [456.395 \times 125 lb/ft^3] \Rightarrow 57{,}049.375$ or $\underline{57.05 K}$

*CASE: ② Water at 494.0 elevation [Rapid Drawdown]

– $\frac{1}{2}(9.33 \times 14 \times 1ft) \Rightarrow$ volume of saturated fill = 65.34 ft^3

$65.34 \times \gamma_{sat}(.141 k/ft^3) = 9.21 K$

– $[456.4 - 65.34] = 391.06 ft^3$ not saturated

$391.06 \times \gamma_{moist}(137 lb/ft^3) = 53{,}574.54 lb$
$\underline{53.57 K}$ } W_{S2} total: 62.7

*CASE: ③ Water at 512.0 elevation

– use γ_{sat} up to el. 512.00, then use γ_{moist} till 517.0

$341.44 cuft \times \gamma_{sat.}(.141 K/ft^3) = 48.14$

$(456.4 - 341.44) \times \gamma_{moist}(.137) = 15.75 K$

$W_{S3\ Total} = \underline{63.89 K}$

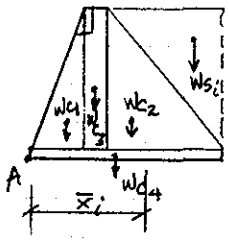
*The weight of the column of water above the structure will not be treated separately within the structural unit.

TOTAL WT. OF STRUCTURAL UNIT: $\boxed{W_{ST}}$

Case 1 ⇒ $W_C + W_{S_1}$ ⇒ 174.25 K
Case 2 ⇒ $W_C + W_{S_2}$ ⇒ 179.98 K
Case 3 ⇒ $W_C + W_{S_3}$ ⇒ 181.09 K

SUBJECT: THOMASTON STABILITY REVIEW
COMPUTATION: SERVICE BRIDGE ABUTMENT
COMPUTED BY: ENESTORIDES CHECKED BY: DATE: Sept. 23, 1986

1. CENTER OF STRUCTURAL SECTION MASS



$W_{ST_1} = 174.25$ k
$W_{ST_2} = 179.98$ k
$W_{ST_3} = 181.09$ k

LOAD	Weight (k)	Moment arm (pt A)	Moment (k·ft)
W_{c1}	24.46	6.17	150.92
W_{c2}	68.46	21.47	1469.84
W_{c3}	18.59	11.25	209.14
W_{c4}	5.69	18.96	107.88
* W_{s1}	* 57.05	29.70	* 1694.39
* W_{s2}	* 62.78	29.70	* 1864.57
* W_{s3}	* 63.89	29.70	* 1897.53
	ΣW = 174.25 / 179.98 / 181.09		ΣM = 3632.17 / 3802.35 / 3835.31

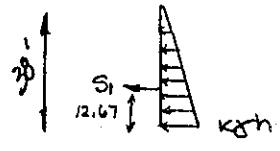
* Depending on Load Case Considered.

$\bar{X}_1 = \frac{\Sigma M}{\Sigma W} \Rightarrow \frac{3632.17}{174.24} = \underline{20.84 \text{ ft}}$ $\quad \bar{X}_2 = \frac{3802.35}{179.98} = \underline{21.13 \text{ ft}}$ $\quad \bar{X}_3 = \frac{3835.31}{181.09} = \underline{21.18 \text{ ft}}$

2. APPLIED LOADING

Bridge Loading $\Rightarrow$ 20.77 k/ft section, $\bar{X} = 9.92$ ft.

Case One: No Water

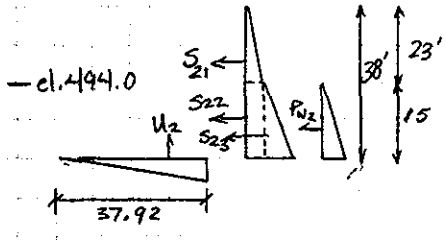


Impervious fill $\gamma_{dry} = .125$ k/ft³ $\quad K = .60$

$S_1 = \frac{1}{2} K \gamma h^2 = \frac{1}{2}(.6)(.125)(38)^2 = \underline{54.15 \text{ k}}$ acting at 12.67 ft.

Case Two: Rapid Drawdown: Water behind abutment el. 494.0

$\gamma_{moist} = .137$ k/ft³
$\gamma_{sat} = .141$ k/ft³
$\gamma_{sub} = .079$ k/ft³



$P_{W2} = \frac{1}{2}(.0625)(15)^2 = \underline{7.03 \text{ k}}$

$S_{21} = \frac{1}{2}(.6)(.137)(23)^2 = \underline{21.74 \text{ k}}$

$S_{22} = (.6)(.137)(23)(15) = \underline{28.36 \text{ k}}$

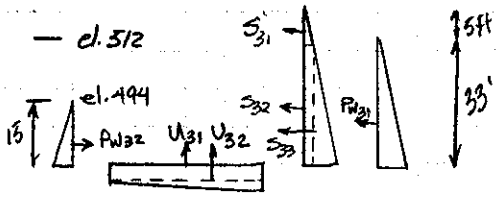
$S_{23} = \frac{1}{2}(.6)(.079)(15)^2 = \underline{5.33 \text{ k}}$

$U_2 = \frac{1}{2}(.0625 \times 15)(37.92) = \underline{17.78 \text{ k}}$

P_{W2} acts at 5 ft
S_{21} " " 22.67 ft
S_{22} " " 7.5 ft
S_{23} " " 5 ft
U_2 " " 25.28 ft

SUBJECT: THOMASTON STABILITY REVIEW
COMPUTATION: Service Bridge Abutment
COMPUTED BY: ENistorides CHECKED BY: DATE: Sept. 23, 1983

Case Three: Max. Pool el. 512.0, water trapped behind abutment pool elevation in front of abutment at spillway crest el. 494.



Load	arm
P_{W31}	11 ft.
P_{W32}	5 ft
S_{31}	1.67 ft
S_{32}	16.5 ft
S_{33}	11 ft.
U_{31}	18.96 ft
U_{32}	25.28 ft.

$P_{W31} = \frac{1}{2}(.0625)(33)^2 = \underline{34.03\ k}$

$P_{W32} = \frac{1}{2}(.0625)(15)^2 = \underline{7.03\ k}$

$S_{31} = \frac{1}{2}(.6)(.137)(5)^2 = \underline{1.03\ k}$

$S_{32} = (.6)(.137)(5)(33) = \underline{13.56\ k}$

$S_{33} = \frac{1}{2}(.6)(.079)(33)^2 = \underline{25.81\ k}$

$U_{31} = (.0625)(15) \times (37.92) = \underline{35.55\ k}$

$U_{32} = \frac{1}{2}(.0625)(33-15)(37.92) = \underline{21.33\ k}$

3. ANALYSIS OF STRUCTURE

$c = .400\ k/ft^2$ $L = 37.92\ ft$

Passive pressures due to rock fill in front of abutment will not be considered.

Case One:

$\frac{37.92}{3} = 12.64$ ⅓ base

± 6.32 from centroid.

Load	Load (K)	Moment arm (pt A)	overturning Moment (K·ft)
P	20.77	9.92 ft	-206.04
W_{ST1}	174.25	20.84	-3631.37
S_1	54.15	12.67	+686.08
			-3151.33

$\Sigma V = 195.02\ k$

$\Sigma H = 54.15\ k$

a. $\frac{\Sigma M}{\Sigma V} = \frac{3151.33}{195.02} = 16.16$ $e = 20.84 - 16.16 = 4.68\ ft.$

OK ✓ within ⅓.

b. Sliding: $S.F. = \frac{\Sigma V \tan\phi + \cancel{cL}^{\,0}}{\Sigma H}$ $\phi = 32$ consolidated drained, $c = 0$

$S.F. = \frac{(195.02)\tan 32^\circ}{54.15} = \underline{2.25}$ OK ✓ > 1.5

c. Base Pressure: $f = \Sigma V / Area \pm Mc/I$

base area $= 37.92\ ft^2$

$I = \frac{(37.92)^3(1)}{12} = 4543.86\ ft^4$ $f = \frac{195.02}{37.92} \pm \frac{(195.02)(2.8)(18.96)}{4543.85}$

$f_+ = 7.42\ k/ft^2$

$f_- = 2.86\ k/ft$ ave $= 5.14\ k/ft^2$

HIGH

SUBJECT: THOMASTON STABILITY REVIEW
COMPUTATION: SERVICE BRIDGE ABUTMENT
COMPUTED BY: ENestorides CHECKED BY: DATE: Sept. 23, 1986

Case Two:

$e = \pm 6.32'$

$\phi = 25°$
Consolidated undrained.

Load	Load (k)	Moment arm (ft)	Overturning Moment (k.ft)
P	20.77	9.92	-206.04
W_{ST_2}	179.98	$\boxed{21.13}$	-3802.98
P_{W2}	7.03	5.0	35.15
S_{21}	21.74	22.67	492.85
S_{22}	28.36	7.5	212.70
S_{23}	5.33	5.0	26.65
U_2	17.78	25.28	449.48
			-2792.19

$\Sigma V = 182.97$ K

$\Sigma H = 62.46$ K

a. Overturning: $\frac{\Sigma M}{\Sigma V} = \frac{2792.19}{182.97} = 15.26$ ft

$e = 21.13 - 15.26 = 5.87$ ft

OK ✓ within 1/3.

b. Sliding: $SF = \frac{(182.97)\tan 25° + (.4)(37.92)}{62.46}$

S.F. = 1.61 OK ✓ $\boxed{> 1.5}$

c. Base Pressure:

$f = \frac{182.97}{37.92} \pm \frac{182.97(3.7)(18.96)}{4543.85} \Rightarrow f_+ = 7.65$ k/ft² $f_- = 2.01$ k/ft²

$f_{ave} = 4.83$ k/ft²

HIGH

Case Three:

$e = \pm 6.32'$

LOAD	Load (k)	Moment arm (PtA) ft.	Overturning Moment (k.ft)
P	20.77	9.92	-206.04
W_{ST_3}	181.09	$\boxed{21.18}$	-3835.49
P_{W31}	34.03	11.0	374.33
P_{W32}	7.03	5.0	-35.15
S_{31}	1.03	1.67	1.72
S_{32}	13.56	16.5	223.74
S_{33}	25.81	11.0	283.91
U_{31}	35.55	18.96	674.03
U_{32}	21.33	25.28	539.22
			-1979.73

$\Sigma V = 144.98$

$\Sigma H = 67.4$

a. Overturning $\frac{\Sigma M}{\Sigma V} = \frac{1979.73}{144.98} = 13.66$ $e = 21.18 - 13.66 = 7.52$ ft.

NOT within 1/3.

b. Sliding: $S.F. = \frac{144.98(\tan 25°) + (.4)(37.92)}{67.4}$

S.F. = 1.23 $\boxed{< 1.5}$

c. Base Pressure: triangular distribution over 15.9 ft of base

$f = \frac{2\Sigma V}{3L(B/2 - e')} \Rightarrow \frac{2(144.98)}{15.9(1)} = 18.24$ k/ft²

HIGH

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SUBJECT THOMASTON DAM STABILITY REVIEW
COMPUTATION PERMEABILITY OF IMPERVIOUS LAYER
COMPUTED BY ENestorides CHECKED BY DATE 9/26/86

FROM DM #4 - Geology + Soils.

Compacted permeability coefficients: .0008 - .09 $\times 10^{-4}$ cm/sec.
most were less than .01 $\times 10^{-4}$ cm/sec

Take an average permeability of about .01 $\times 10^{-4}$ cm/sec } conserva assump.

$$.01\times10^{-4}\frac{cm}{sec}\times\frac{3600\,sec}{1\,hr}\times\frac{24\,hr}{1\,day}\times\frac{1\,in}{2.54\,cm}\times\frac{1\,ft}{12\,in}=0.0028\,ft/day$$

The length of an average path for water to seep behind the abutment is 21 ft

$$21\,ft/.0028\,ft/day = \underline{\underline{7500\text{ days}}}\ !!$$

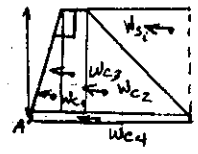
Load Case 3 is not a feasible Load case.

Therefore, we will not consider this Load case in our review of the structural stability of the abutment.

SUBJECT: THOMASTON STABILITY REVIEW
COMPUTATION: SERVICE BRIDGE ABUTMENT
COMPUTED BY: ENestoridis CHECKED BY: DATE: Sept. 23, 1986

1. EARTHQUAKE LOADING

a. FIND $\bar{Y}$



* depending on Load Case.

$$\bar{Y} = \frac{\Sigma M}{\Sigma W}$$

Load	Weight (k)	Momentarm (y-axis) ft. A.	Moment (k.ft)
W_{c1}	24.46	13.33	326.05
W_{c2}	68.46	13.33	912.57
W_{c3}	18.59	19.5 ft	362.51
W_{c4}	5.69	0.5 ft	2.85
* W_{S1}	* 57.05	25.67	*1464.47
* W_{S2}	* 62.78	25.67	*1611.56
* W_{S3}	* 63.89	25.67	*1640.06
	ΣW = 174.25 / 179.98 / 181.09		ΣM = 3068.45 / 3215.54 / 3244.04

$$\bar{Y}_1 = \frac{3068.45}{174.25} \qquad \bar{Y}_2 = \frac{3215.54}{179.98} \qquad \bar{Y}_3 = \frac{3244.04}{181.09}$$

$\bar{Y}_1 = 17.61$ ft, $\bar{X}_1 = 20.84$ ft $\bar{Y}_2 = 17.87$ ft, $\bar{X}_2 = 21.18$ ft $\bar{Y}_3 = 17.91$ ft, $\bar{X}_3 = 21.18$ ft

Thomaston, CT is zone 2 ⇒ .1g acceleration $g = 32.2$ ft/sec²

$F = ma = \frac{W}{g}(.1g)$

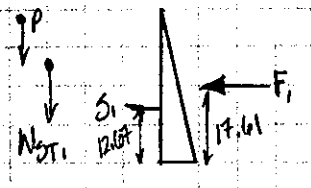
$F_1 = (174.25\text{ k})(.1) = 17.43$ k } Load Case One.

$F_2 = (179.98)(.1) = 18.00$ k
$F_3 = (181.09)(.1) = 18.11$ k } Not considered.

WORST CASE:

Worst case is to apply the earthquake force in the same direction as the burden soil loads.

High pools or rapid drawdown are not the normal operation conditions of this abutment, therefore, only Load Case One will be considered with earthquake Loading.



LOAD	r	Moment
S_1 = 54.15 k	12.67	+686.08
F_1 = 17.43 k	17.61	+306.94
W_{ST_1} = 174.25 k	20.84	−3631.37
P = 20.77 k	9.92	−206.04
		−2844.39

$\Sigma V = 195.02$ k $\Sigma H = 71.58$ k

SUBJECT THOMASTON STABILITY REVIEW
COMPUTATION Service Bridge Abutment
COMPUTED BY ENestorides CHECKED BY DATE Sept. 23, 1986

4. Cont.

a. Overturning moment: $\frac{\Sigma M}{\Sigma V} = \frac{2844.39}{195.02} = 14.56$

$e = \pm 6.32$ from centroid.

$e = 20.84 - 14.56 = \underline{6.25}$

OK still in 1/3 of base. ✓

b. Sliding: $SF = \frac{\Sigma V \tan\phi + \cancel{cL}^{\to 0}}{\Sigma H}$

$\phi = 32$ consolidated
$c = 0$ tsf. drained

$SF = \frac{195.02 (\tan 32°)}{71.58} = \underline{\underline{1.7}}$ $\underline{\underline{OK}}$ ✓ $\boxed{> 1.33}$

c. Base Pressure: $f = \frac{195.02}{37.92} \pm \frac{195.02 (4.4)(18.96)}{4543.85}$

$f_+ = 8.72$ k/ft²
$f_- = 1.56$ k/ft²

$f_{ave.} = 5.14$ k/ft²
HIGH

SUBJECT THOMASTON STABILITY REVIEW
COMPUTATION SERVICE BRIDGE ABUTMENT
COMPUTED BY E Nestorides CHECKED BY DATE 9/18/86

SOIL PARAMETERS

Impervious: Glacial till

$\gamma_{dry} = 125$ $\gamma_{sat} = 141$ $\gamma_{moist} = 137$ $\gamma_{sub} = 79$ } p. 13. DM 7 Verified by GEB letter.

$K_{at\ rest} = .60$

p. 15 DM #7 allowable bearing 3 tons/ft² = 6000 lb/ft²
p. 15 DM #4

To Be used
S (CD) Consolidated Drained $\phi = 32°$ $C = 0.0$ tsf
R (CU) " Undrained $\phi = 25°$ $C = .2$ ton/ft² ⇒ 400 lb/ft
Q (UU) Unconsolidated Undrain $\phi = 18°$ $C = .5$ ton/ft² ⇒ 1000 lb/ft²

Post Construction settlement expected negligible.

Select Pervious:
DM #7 : p.13
$\gamma_{dry} = 128$ $\gamma_{sat} = 148$ $\gamma_{moist} = 144$ $\gamma_{sub} = 86$ $K_0 = .43$

To Be used
CD $\phi = 45°$ $C = 0.0$ tsf
CU $\phi = 40°$

Rockfill:
$\gamma_{dry} = 115$ $\gamma_{sat} = 137$ $\gamma_{moist} = 119$ $\gamma_{sub} = 74$ $K_0 = .45$

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U S ARMY

PAGE 1

SUBJECT THOMASTON DAM - SERVICE BRIDGE
COMPUTATION COMPUTE DEAD WEIGHT
COMPUTED BY D. D. CHECKED BY DATE 10/6/81

COMPUTE DEAD WEIGHT OF SERVICE BRIDGE

1. ROADWAY SLAB
$(12)(154)(7/12)(150\ \#/FT^3) =$ 161700#

2. CONCRETE CURBS
$2(1)(10/12)(154)(150\ \#/FT^3) =$ 38500

3. POSTS AND RAILS
4-4" O.D. RAILS $4(154)(9.11\ \#/FT) =$ 5610

44-POSTS, 6 H20, 3'-5" HT. $44(3.42)(20\ \#/FT) =$ 3010

336-1"ϕ PALINGS, 2'-8" HT $336(2.67)(2.673\ \#/FT) =$ 2400

44 BASE PLS - 12"x10"x 3/4" $\frac{44(12 \times 10 \times 3/4)}{12^3}(490\ \#/FT^3) =$ 1120

4. PLATE GIRDERS (2)

2 WEB PLATES $2(6)(154)\frac{(7/16)}{12}(490\ \#/FT^3) =$ 33010

FLANGE PLATES
8 PLS 7/8" x 1'-8" x 21' $8\frac{(7/8)}{12}(1.61)(21)(490\ \#/FT^3) =$ 10020

4 PLS 2 1/4" x 1'-8" x 35' $4\frac{(2\ 1/4)}{12}(1.67)(35)(490\ \#/FT^3) =$ 21480

4 PLS 1 3/4" x 1'-8" x 21' $4\frac{(1\ 3/4)}{12}(1.67)(21)(490\ \#/FT^3) =$ 10020

4 PLS 1" x 1'-8" x 21' $4\frac{(1)}{12}(1.67)(21)(490\ \#/FT^3) =$ 5730

4 PLS 1 1/4" x 1'-8" x 35' $4\frac{(1\ 1/4)}{12}(1.67)(35)(490\ \#/FT^3) =$ 11930

108 STIFFENER PL. $108\frac{(1/2 \times 8)}{12^2}(6)(490\ \#/FT^3) =$ 8820

SUB-TOTAL 313350#

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SUBJECT THOMASTON DAM - SERVICE BRIDGE
COMPUTATION DEAD WEIGHT
COMPUTED BY D.C. CHECKED BY DATE 10/9/81

SUB-TOTAL FROM PRECEDING PAGE	313350#
5. DIAPHRAGMS 24 - W36X150 24 (1.5)(150 #/FT) =	27000
CONNECTION PLS. 20 PLS 5/8" x 6 1/2" x 5' $20 \frac{(5/8 \times 6\frac{1}{2})}{12^2}(5)(490\ \#/FT^3) =$	1380
4 PLS 1" x 9" x 5' $4 \frac{(1 \times 9)}{12^2}(5)(490\ \#/FT^3) =$	610
6. FUEL TANK (ASSUME 1/8" TK. STEEL TANK) $\left[\pi(4)(10.75)\frac{(1/8)}{12} + 2\pi(2)^2\frac{(1/8)}{12}\right](490\ \#/FT^3) =$	820
2- 8W 17 SUPPORTS 2(17)(14.5)	490
4- 4M 13 TANK CRADLES 4(13)(6.28)	330
OIL IN TANK $\pi(2)^2(10.75)(57\ \#/FT^3)$	7700
TOTAL	351680#

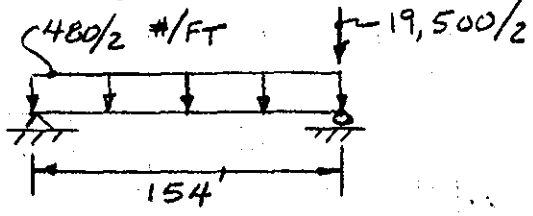
REACTION AT EACH BEARING $= \frac{351,680}{(4)(1000)} = 87.9$ K

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT THOMASTON DAM - SERVICE BRIDGE
COMPUTATION LIVE LOADS
COMPUTED BY D.D. CHECKED BY DATE 10/27/81

COMPUTE LIVE LOAD REACTION AT BEARING
HIS LOAD



REACTION = (480/2)(154/2) + 19,500/2 = 28,230 #
= 28.2 K

REACTION DUE TO LIVE LOAD PLUS IMPACT (30%)
= 28.2 (1.3) = 36.7 K

DEAD LOAD REACTION = 87.9 K (SEE p. 2)

TOTAL REACTION $_{D+L+I}$ = 87.9 + 36.7 = 124.6 K

NOTE: LUBRITE F EXPAN. RADIAL BEARING ASSEMBLY WITH 150 K CAPACITY CAN BE USED

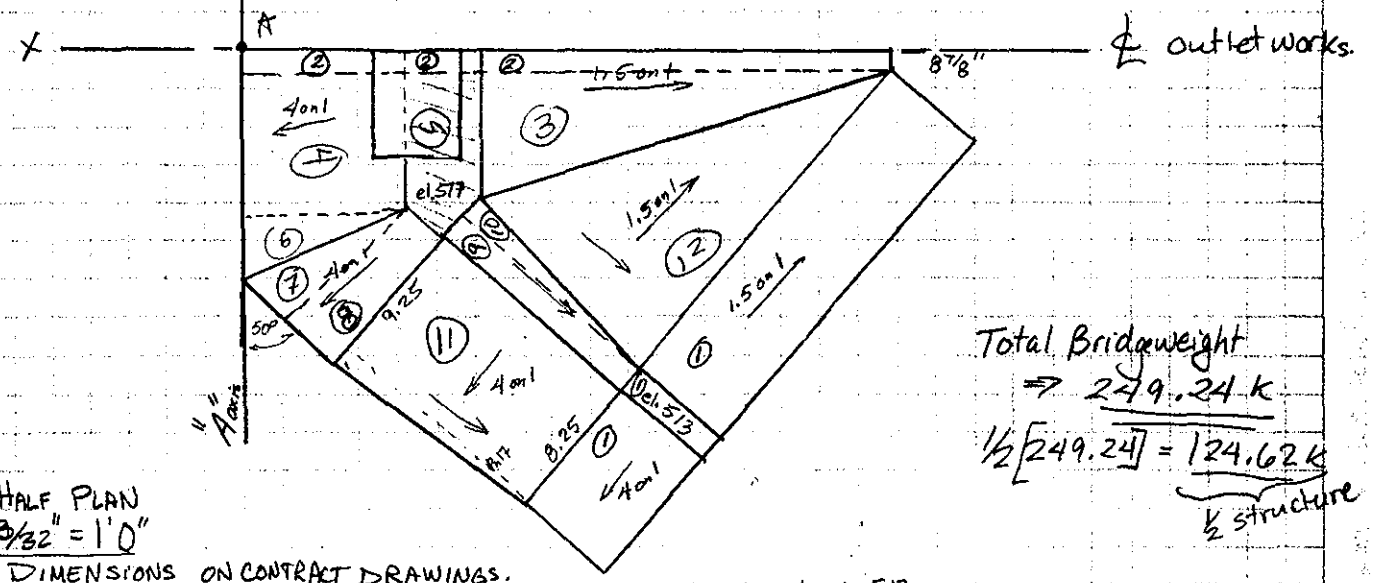
SUBJECT THOMASTON DAM – STABILITY REVIEW

COMPUTATION SERVICE BRIDGE ABUTMENT.

COMPUTED BY ENestorides CHECKED BY DATE 9/30/86

VOLUME AND MASS CALCULATIONS

Since the abutment is symmetrical about the outlet works ℄, we will concentrate on ½ the structure.



Total Bridgeweight ⇒ 249.24 k

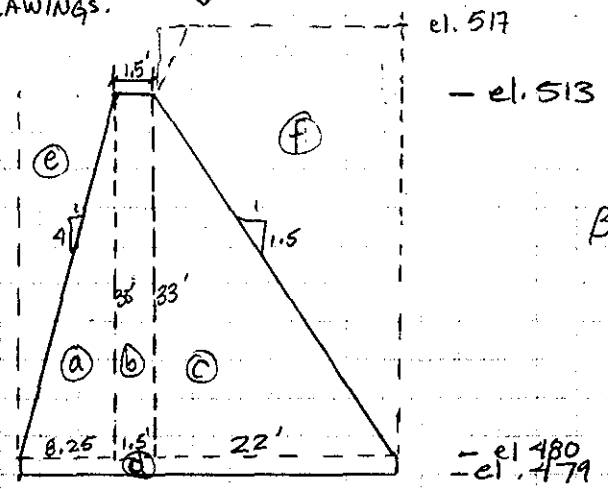
½[249.24] = 124.62 k (½ structure)

HALF PLAN
3/32" = 1'0"
DIMENSIONS ON CONTRACT DRAWINGS.

PART ONE
Weight

SECTION (1)

6 ft deep section



Base area = 190.5 ft²

use $\gamma_{dry} = .137$ k/ft³
$\gamma_c = .15$ k/ft³

$V_a = \frac{1}{2}(8.25 \times 33') \times 6' = 816.75 \text{ ft}^3$

$V_b = (1.5')(33')(6') = 297 \text{ ft}^3$

$V_c = \frac{1}{2}(22)(33)(6) = 2178 \text{ ft}^3$

$V_d = 1'(8.25 + 1.5 + 22) \times 6' = 190.5 \text{ ft}^3$

$V_{con} = 3482.25 \text{ ft}^3$

$V_e = V_a = 816.75 \text{ ft}^3$

$V_f = V_c + (4' \times 22')(6') = 2178 + 528 = 2706 \text{ ft}^3$

$V_s = 3522.75 \text{ ft}^3$

W_T = Total Weight ⇒ $(3482.25)(.15) + (3522.75)(.137) = 1004.95$ k

SUBJECT THOMASTON DAM - STABILITY REVIEW
COMPUTATION SERVICE BRIDGE ABUTMENT (M calcs)
COMPUTED BY E Nestorides CHECKED BY DATE 9/30/86.

Section ②

.74 ft deep section

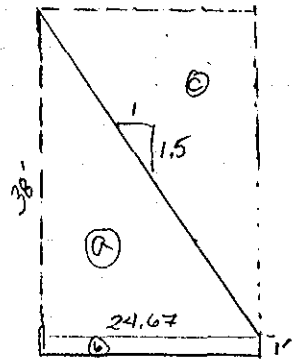
From stability computations: $A_c = 781.32\ ft^2$ $V_c = 781.32 \times .74 = 578.18$
$A_s = 506.4\ ft^2$ $V_s = 506.4 \times .74 = 374.74\ ft^3$

$$\text{Weight} = W_2 = (578.18)(.15) + (374.74)(.137) = \underline{132.07\ K}$$

Section ③

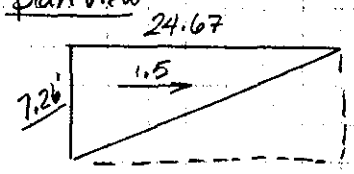
7.26' deep section (half)*

Since soil and concrete is about the same weight..... you can assume ½



* Assume whole section for calculations

plan view

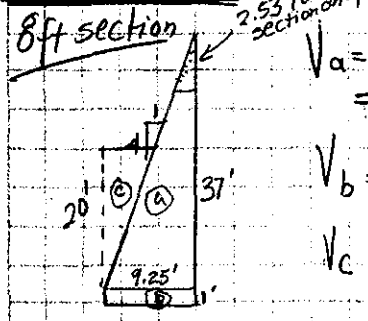


base area = 89.55 ft²

$$V_a = \tfrac{1}{2}(37' \times 24.67) \times 7.26' = 3313.43$$
$$V_b = 1'(24.67)(7.26') = 179.10$$
$$V_{con} = 3492.53\ ft^3$$
$$V_c = V_a = 3313.43\ ft^3$$
$$W_3 = (3492.53)(.15) + 3313.43(.137) = \underline{977.82\ K}$$

Section ④

8ft section



$$V_a = \left[\tfrac{1}{2}(9.25)(37) - \tfrac{1}{2}(2 \times 8.03)\right](8') + \tfrac{1}{2}(2 \times 8.03)(2.53')$$
$$= 1325.08\ ft^3$$
$$V_b = (9.25 \times 1')(8') = 74\ ft^3$$
$$V_{con} = 1399.08$$
$$V_c = \tfrac{1}{2}(20' \times 5')(8') = 400\ ft^3$$

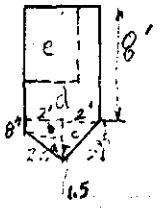
base area = 9.25 × 8 = 74 ft²

$$W_4 = 1399.08(.15) + 400(.137) = \underline{264.66\ K}$$

SUBJECT THOMASTON DAM
COMPUTATION Service Bridge Abutment (N) calcs.
COMPUTED BY E Westerides CHECKED BY DATE 9/30/86

Section (5)

Plan 38 feet deep



$V_a = \frac{1}{2}(1.5' \times 2')\ 38\,ft = 57\ ft^3$

$V_b = (.67' \times 2')\ 38' = 50.92\ ft^3$

$V_c = \frac{1}{2}(2.17 \times 2)\ 38 = 82.46\ ft^3$

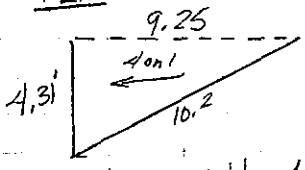
$V_d - V_e = (8' \times 4')38' - (3' \times 6.08')(8.03') = 1069.53$

1259.91

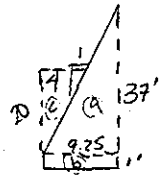
$W_5 = .15(1259.91) = \underline{188.99\ K}$

Section (6)

PLAN



ELEVATION



$A_a = \frac{1}{2}(9.25 \times 37) = 171.13\ ft^2$

$A_b = 9.25 \times 1\,ft = 9.25\ ft^2$

$A_c = \frac{1}{2}(5 \times 20) \Rightarrow 50\ ft^2$

Since weights of soil & concrete are similar assume ½ section

$V_a = 171.13 \times \frac{4.31}{2} = 368.79\ ft^3$

$V_b = 9.25 \times \frac{4.31}{2} = 19.93\ ft^3$

388.72 ft³

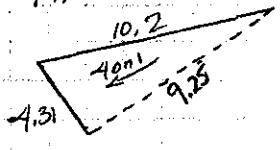
$V_c = 50 \times \frac{4.31}{2} = 107.75\ ft^3$

$W_6 = .15(388.72) + .137(107.75)$

$= \underline{73.07\ K}$

Section (7)

PLAN



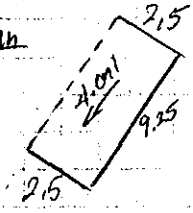
This section is similar to section (6)

Assume equal Volume & Weight

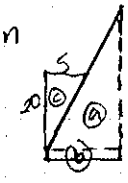
$W_7 = \underline{73.07\ K}$

Section (8)

Plan



elevation



$V_a = 171.13 \times 2.5' = 427.83\ ft^3$

$V_b = 9.25 \times 2.5 = 23.125\ ft^3$

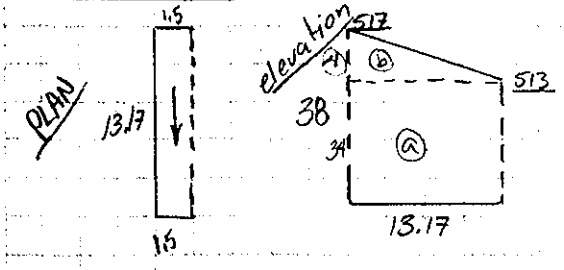
460.96 ft³

$V_c = 50 \times 2.5 = 125\ ft^3$

$W_8 = .15(460.96) + .137(125) = \underline{86.27\ K}$

SUBJECT: THOMASTON DAM – STABILITY REVIEW
COMPUTATION: SERVICE BRIDGE ABUTMENT (M) Calcs.
COMPUTED BY: E Nestaridies CHECKED BY: DATE: 9/30/86

Section (9)



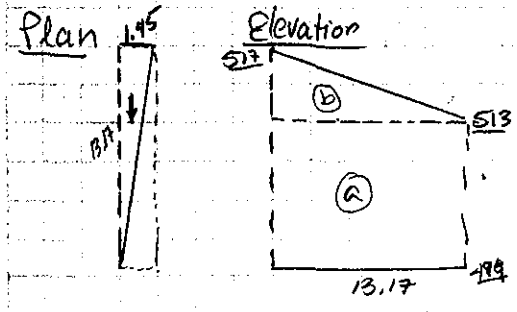
$V_a = 34 \times 13.17 \times 1.5 = 671.67$

$V_b = \frac{1}{2}(4 \times 13.17)(1.5) = 39.51$

$711.18\ ft^3$

$W_9 = .15(711.18) \Rightarrow \underline{106.68\ K}$

Section (10)



$V_a \Rightarrow$ ½ of 1.45 deep section

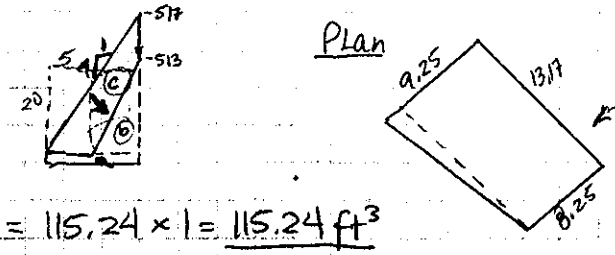
$V_a = [34 \times 13.17 \times 1.45] \times .5 = 324.64\ ft^3$

$V_b = [\frac{1}{2}(13.17 \times 1.45) \times 4] \times \frac{1}{2} = 19.10\ ft^3$

$343.$

$W_{10} = .15(343.74\ ft^3) = \underline{51.56\ K}$

Section (11)



area $= (8.25 \times 13.17) + \frac{1}{2}(13.17)(1)$

$A = 115.24\ ft^2$

$V_a = A \times 1ft = 115.24 \times 1 = \underline{115.24\ ft^3}$

– Take average of area (b) and area (c) and multiply by section depth 13.17

$A_b = 136.125\ ft^2$
$A_c = 171.125\ ft^2$
$A_{ave.} = 153.625\ ft^2$

$V_{bc} = 153.625 \times 13.17 = \underline{2023.24\ ft^3}$

– Soil layers will be treated the same

at b soil is at elevation 513 so $A_{b_{soil}} = 136.125\ ft^2$
at c soil is at elevation 500 so $A_{c_{soil}} = 50\ ft^2$
$A_{ave} = 93.0625\ ft^2$

$V_{s_{bc}} = 93.063 \times 13.17 = 1225.63$

SUBJECT: THOMASTON DAM - STABILITY REVIEW
COMPUTATION: Service Bridge Abutment (M) Calcs.
COMPUTED BY: E Nestorides CHECKED BY: DATE: 9/30/86

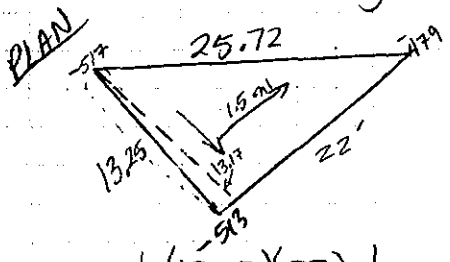
$$V_a + V_{bc} = 115.24 + 2023.24 = 2138.48\ ft^3$$

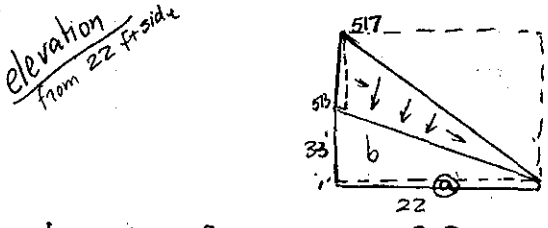
$$V_{S_{bc}} = 1225.63\ ft^3$$

$$W_{11} = .15(2138.48) + .137(1225.63) = \underline{488.68\ K}$$

Section (12)

Concrete is sloping while soil is not. Top of soil = elevation 517.0





$$area = \tfrac{1}{2}(13.17)(22)$$

$$A = 144.87\ ft^2$$

$$V_a = A \times 1\,ft = \underline{144.87\ ft^3}$$

$$A_b = \tfrac{1}{2}(22)(33) = 363\ ft^2$$

This is a very complicated shape; since soil elevation is at 517.0 and the structure would be a prism if you considered the soil and concrete alike, consider a prismodial shape of $\gamma = \frac{\gamma_c + \gamma_s}{2}$

$$\text{base Area} = 144.87 \times 38\,ft \Rightarrow 5505.06\ ft^3$$

$$W_{12} = \left(\frac{.15 + .137}{2}\right) 5505.06 = \underline{789.98\ K}$$

TOTAL WEIGHT OF STRUCTURAL WEDGE.

$$W_T = \sum_{i=1}^{12} W_i + \text{Bridge} \Rightarrow 4237.8^k + 124.62^k = \underline{4362.42\ K}$$

$$\text{Base area of } \tfrac{1}{2} \text{ structure} \Rightarrow 771.52\ ft^2$$

$$\frac{\Sigma V}{A} \Rightarrow \frac{4362.42}{771.52} = \underline{5.65\ K/ft^2} \quad \text{average bearing pressure}$$

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: THOMASTON DAM - STABILITY REVIEW
COMPUTATION: Service Bridge Abutment
COMPUTED BY: ENestorides CHECKED BY: DATE: 9/30/86

PART TWO
Center of gravity

Section One:

Section	(K) Value	(ft) moment arm x	(K·ft) Moment x	(ft) moment arm y	(K·ft) Moment y
Wa	122.5	5.5	673.8	12	1470.0
Wb	44.6	9	401.4	17.5	780.5
Wc	326.7	17.1	5581.1	12	3920.4
Wd	28.6	15.8	453.0	0.5	14.3
We	111.9	2.8	307.7	23	2573.7
Wf	370.7	24.42	9051.3	25.33	9391.1
	1005.00		16,468.3		18150.0

$\Sigma M_x / \Sigma V = \frac{16468.3}{1005.0} = 16.39' = \bar{x}$ $\Sigma M_y / \Sigma V = \frac{18150}{1005} = 18.06' \leftarrow \bar{y}$

Graphical Solution:
$\bar{X}_A$ distance $\Rightarrow$ 28.4
$\bar{y}_A = 18.1'$

Section Two:

from stability computations $\bar{x}_A = 20.84$ $y = 17.61$

Section Three:

section	Value	rx	Mx	ry	My
Wa	497.0	21.47	10670.6	13.33	6626.7
Wb	26.9	25.6	688.4	.5	13.45
Wc	453.9	29.7	13480.8	25.67	11650.1
	977.8		24,839.8		18,290.3

$\Sigma M_x / \Sigma V = \frac{24839.8}{977.8} = 25.4'$ $\Sigma M_y / \Sigma V = \frac{18290.3}{977.8} = 18.7'$

Section Four:

Section	Value	rx	Mx	ry	My
Wa	198.8	6.2	1225.9	13.3	2650.7
Wb	11.1	4.6	51.3	.5	5.55
Wc	54.8	1.3	71.24	14.3	785.47
	264.7		1348.44		3441.7

$\Sigma M_x / \Sigma V = \frac{1348.44}{264.7} = 5.1' = \bar{x}$ $\Sigma M_y / \Sigma V = \frac{3441.7}{264.7} = 13.0' = \bar{y}$

SUBJECT THOMASTON DAM - STABILITY REVIEW
COMPUTATION SERVICE BRIDGE ABUTMENT
COMPUTED BY ΣNestorides CHECKED BY DATE 9/30/86

Section 5

Section	Value	rx	Mx	ry	My
Wa	8.55	10.58	90.46	19	162.45
Wb	7.6	10.25	77.90	19	144.40
Wc	12.4	11.92	147.81	19	235.60
WD	160.4	11.25	1804.50	19	3047.60
	188.99		2120.67		3590.05

$\Sigma M_x / \Sigma V = \frac{2120.67}{188.99} = \boxed{11.22'}$ $\Sigma M_y / \Sigma V = \frac{3590.05}{188.99} = 19'$

Section 6

section	Value	rx	Mx	ry	My
Wa	55.32	6.17	341.3	13.3	737.6
Wb	2.99	4.63	13.84	0.5	1.5
Wc	14.76	1.7	26.93	14.33	231.63
	73.07		382.07		970.73

$\Sigma M_x / \Sigma V = \frac{382.07}{73.07} = \boxed{5.23'}$ $\Sigma M_y / \Sigma V = \frac{970.73}{73.07} = 13.28.$

Section 7

The $\bar{x}$ and $\bar{y}$ coordinates are the same as section 6 but the orientation of the section is different.

$\therefore \bar{X}_A \Rightarrow \boxed{5.5'}$

Section 8

Section	Value	rx	Mx	ry	My
Wa	65.67	6.17	405.18	13.3	873.4
Wb	3.47	4.63	16.07	0.5	1.74
Wc	17.13	1.7	29.12	14.33	245.77
	86.27		450.37		1120.92

$\Sigma M_x / \Sigma V = \frac{450.37}{86.27} = \boxed{5.22}$ $\Sigma M_y / \Sigma V = \frac{1120.92}{86.27} = \boxed{12.99}$

SUBJECT: THOMASTON DAM STABILITY REVIEW
COMPUTATION: SERVICE BRIDGE ABUTMENT (M Calcs)
COMPUTED BY: ENestorides CHECKED BY: DATE: 9/30/86

Section (9)

SECTION	VALUE	rx	Mx	ry	My
Wa	100.75	6.59	663.4	17	1712.75
Wb	5.93	4.39	26.03	35.33	209.53
	106.68		689.43		1922.28

$\Sigma M_x / \Sigma V = \frac{689.43}{106.68} = 6.5'$ $\Sigma M_y / \Sigma V = \frac{1922.28}{106.68} = 18.02'$

$\bar{X}_A = \boxed{16.6'}$

Section (10)

Section	Value	rx	Mx	ry	My
Wa	48.7	6.59	320.93	17	827.9
Wb	2.86	4.39	12.60	35.3	101.41
	51.56		333.53		929.31

$\Sigma M_x / \Sigma V = \frac{333.53}{51.56} = 6.47$ $\Sigma M_y / \Sigma V = \frac{929.31}{51.56} = 18.02$

$\bar{X}_A = \boxed{17.4}$

Section (11)

Section	Value	rx	Mx	ry	My
Wa	17.29	4.38	75.64	0.5	8.65
Wbc	303.49	5.83	1770.36	12.67	3844.21
Wsbc	167.9	1.67	280.41	14.33	2406.01
	488.68		2126.41		6258.87

$\Sigma M_x / \Sigma V = \frac{2126.41}{488.68} = 4.35'$ $\Sigma M_y / \Sigma V = \frac{6250.87}{488.68} = 12.81'$

$\boxed{\bar{X}_A = 13.5}$

Section (12)

This is a very complex 3D element. I will estimate centroids distance from a-axis at $X_A = \boxed{22 ft}$

SUBJECT THOMASTON DAM - STABILITY REVIEW
COMPUTATION SERVICE BRIDGE ABUTMENT
COMPUTED BY ENestorides CHECKED BY DATE 9/30/86

ΣM about toe ("A"-axis) 1/2 structure

Section		Weight	Moment Arm	ΣM about A-axis
Sect./One	W_1	1004.95	28.4	28540.58
/Two	W_2	132.1	20.84	2752.96
/Three	W_3	977.8	25.4	24836.12
/Four	W_4	264.7	5.1	1349.97
/Five	W_5	189	11.22	2120.6
/Six	W_6	73.07	5.23	382.16
/Seven	W_7	73.07	5.5	401.89
/EIGHT	W_8	86.27	7.7	664.28
/NINE	W_9	106.68	16.16	1770.89
/TEN	W_{10}	51.56	17.4	897.14
/ELEVEN	W_{11}	488.68	13.5	6597.18
/TWELVE	W_{12}	789.98	22.0	17,379.56
BRIDGE		124.62	9.92	1236.23
LATERAL SOIL		* 1570.35	12.67	-19896.33
		$\Sigma V = 4362.42$		$\Sigma M = 69,033.23$

$\frac{\Sigma M}{\Sigma V} = 15.82$

assume average $L = 21$
$B_{ave} = 37.92$

$e = 18.96 - 15.82 = 3.14$

$$f = \frac{\Sigma V}{Area} \pm \frac{\Sigma V\, 6e}{B^2 L}$$

$$f_{+/-} = \frac{4362.42}{771.52} \pm \frac{4362.42(6)(3.14)}{(37.92)^2\, 21}$$

$$f_+ = 8.376\ K/ft^2 \qquad f_- = 2.93\ K/ft^2$$

Too High for allowable $6\ K/ft^2$