

```

*****
*          CAST-UTILITY BY CAST INC.                      *
*                                                         *
*          M A S O N      &      H A N G E R      ENGINEERS *
*                                                         *
*                                     TIME: 9/24/98 14:37:51    PAGE: 2 *
*****

```

```

*****
* DETAILS OF THE ANALYSIS *
*****

```

\* DISPLACEMENT AT OUTPUT POINTS :

At X=	0.0000	Displacement=	0.00000
At X=	27.5000	Displacement=	0.02138
At X=	55.0000	Displacement=	0.06964
At X=	75.5000	Displacement=	0.11077
At X=	82.5000	Displacement=	0.12434
At X=	110.0000	Displacement=	0.16952
At X=	116.0000	Displacement=	0.17690
At X=	122.0000	Displacement=	0.18318
At X=	128.0000	Displacement=	0.18829
At X=	134.0000	Displacement=	0.19218
At X=	151.0000	Displacement=	0.19641
At X=	176.0000	Displacement=	0.18457
At X=	218.0000	Displacement=	0.12450
At X=	226.5000	Displacement=	0.10836
At X=	260.0000	Displacement=	0.04386
At X=	302.0000	Displacement=	0.00000

\* SHEAR FORCES :

Coordinate	Shear (LT side)	Shear (RT side)
X=	0.0000	29941.4260
X=	27.5000	25001.6010
X=	55.0000	20061.7760
X=	75.5000	16379.3610
X=	82.5000	15121.9510
X=	110.0000	10182.1260
X=	116.0000	8120.7660
X=	122.0000	6059.4060
X=	128.0000	3998.0460
X=	134.0000	1936.6860
X=	151.0000	-1249.1140
X=	176.0000	-5934.1140
X=	218.0000	-13804.9140
X=	226.5000	-15397.8140
X=	260.0000	-21675.7140
X=	302.0000	-29546.5140

\* MOMENTS :

Coordinate	Moment (LT side)	Moment (RT side)
X=	0.0000	1558968.1077
X=	27.5000	803501.4873
X=	55.0000	183880.0543
X=	75.5000	-189641.5994

```

*****
*      CAST-UTILITY  BY  CAST INC.      *
*                                         *
*      M A S O N      &      H A N G E R      ENGINEERS      *
*                                         *
*                                         TIME: 9/24/98 14:37:51      PAGE:      3      *
*****

```

X=	82.5000	-299896.1912	-299896.1912
X=	110.0000	-647827.2492	-647827.2492
X=	116.0000	-702735.9250	-702735.9250
X=	122.0000	-745276.4408	-745276.4408
X=	128.0000	-775448.7966	-775448.7966
X=	134.0000	-793252.9925	-793252.9925
X=	151.0000	-799097.3540	-799097.3540
X=	176.0000	-709307.0033	-709307.0033
X=	218.0000	-294787.4141	-294787.4141
X=	226.5000	-170675.8199	-170675.8199
X=	260.0000	450305.7751	450305.7751
X=	302.0000	1525972.5643	

# Pilast5.in CBARCS Program

```
100 0,0,0,0,1.17
110 P501 MAG - 25.156' x 36" x 60" DEEP PILASTER, 2 DEG, 2 ENDS FIXED
120 0,1,0,0,0,0
130 350000,1,0,0,0,0,0,0
140 1872,25.156,3.00,152.0,24.6,0,0,0,0,0,0
150 4760,66000,60,2,6,0,0,0
160 3.64,3.64,0.30,0.30,2.705,2.705,1.75,1.75
```

$$7 \# 11s \Rightarrow A_s = 1.56 \times 7 \times \frac{1}{3} = 3.64 \text{ in}^2/\text{ft.}$$

$$M_E = 9705.60$$

$$K_E = 1566.34$$

$$r_u = 223.73$$

Use these for Input Values for SOLVER

# Pilast5.out CBARCS Output

P501 MAG - 25.156' x 36" x 60" DEEP PILASTER, 2 DEG, 2 ENDS FIXED

BLAST WALL HEIGHT	25.16 FT
BLAST WALL LENGTH	3.00 FT
DURATION OF LOAD	24.60000 MSEC
FICTITIOUS PEAK PRESSURE	152.00000 PSI
EFFECTIVE IMPULSE	1872.00 PSI MS

HEIGHT	301.87 IN	LENGTH	36.00 IN
DYNAMIC CONCRETE STRENGTH	4760.00		
DYNAMIC STEEL STRESS	77220.00		
THICKNESS CONCRETE INCHES	60.0000		
THICKNESS OF SAND INCHES	.0000		
THETA ALLOWABLE DEGREES	2.0000		

AREA VERT TOP STEEL/FT	3.6400	COVER	2.7050
AREA VERT BOT STEEL/FT	3.6400	COVER	2.7050
AREA HORIZ TOP STEEL/FT	.3000	COVER	1.7500
AREA HORIZ BOT STEEL/FT	.3000	COVER	1.7500

## TYPE 1 CONSTRUCTION

CONCRETE MODULUS PSI	3555611.
RATIO MOD STEEL/CONCRETE	8.16
GROSS MOMENT INERTIA	18000.00
AVE CRACKED MOM INERTIA	5816.13
AVE MOMENT INERTIA	11908.06
AVERAGE PERCENT STEEL	.0053
D FACTOR MU=1/6	43551157956.
D FACTOR MU= 0.3	46527948921.

ALLOW SHEAR UNREINFORCED WEB	110.91 PSI	6354.60 LBS/IN
WIDTH		
ALLOW SHEAR AT SUPPORT	753.98 PSI	43199.52 LBS/IN
WIDTH		
UNREINFORCED CONCRETE THETA LE 2 DEG		

POSITIVE VERTICAL MOMENT	1274241.47
NEGATIVE VERTICAL MOMENT	1274241.47
POSITIVE HORIZONTAL MOMENT	111991.07
NEGATIVE HORIZONTAL MOMENT	111991.07
FIXED END BEAM	

LOCATION YIELD LINE LENGTH	.00
LOCATION YIELD LINE HEIGHT	150.94
ULTIMATE LOAD CAPACITY RU	223.7309
SHEAR LOAD AT VERTICAL SUPPORT	.00 LB/IN WIDTH
SHEAR LOAD AT HORIZONTAL SUPPORT	33769.05 LB/IN WIDTH

SHEAR AT DISTANCE FROM VERTICAL SUPPORT	.00 PSI
SHEAR AT DISTANCE FROM HORIZONTAL SUPPORT	365.66 PSI
ALLOWABLE MAX DEFLECTION	5.2796

LOAD MASS FACTOR	.7200
MASS CONCRETE ONLY	9705.60

SHEAR CAPACITY(VC) EXCEEDED

ELASTIC LIMIT RE PSI	167.80
ELASTIC DEFLECTION XE	.0857
ULTIMATE RESISTANCE	223.73
PLASTIC DEFLECTION	.2285

ULTIMATE RESISTANCE RU	223.73
ELASTIC DEFLECTION LIMIT XE	.1428
STIFFNESS KE	1566.34

MASS	9705.600
LOAD	152.000
DURATION	24.600
RESISTANCE	223.731
STIFFNESS	1566.337

GAS PRESSURE	.00	DURATION	.00
NATURAL PERIOD			15.640410
MAXIMUM DEFLECTION			.167360
TIME TO MAXIMUM DEFLECTION			7.617367
DURATION/NATURAL PERIOD			1.572849
LOAD/RESISTANCE			.679387
ELASTIC DEFLECTION LIMIT			.142837

MAX FRAGMENT SPALL VELOCITY FT/SEC	2.918600
------------------------------------	----------

# Pilast5 SOLVER Program

```

SOLVE  PILAST5 ANALYSIS OF 36" x 60" x 25.16' PILASTER, FIXED EA END
  1      1      .05      100      -1

  2      2      9705.60      0.01
  1      1566.34      223.73      1.0      1.0
  3      0.0      10      1.0      0.0
  1      1566.34      -223.73      1.0      1.0
  3      0.0      -10      1.0      0.0
  1      5
    0.0      152      3.60      334.86      24.62      205.1      29.75
0.0
    40.0      0.0
STOP

```

# Pilast5.out SOLVER Output

1ONE DEGREE OF FREEDOM SOLVER INPUT  
VERSION 2.2 FEB 1989

## PROBLEM DESCRIPTION

SOLVE PILAST5 ANALYSIS OF 36" x 60" x 25.16' PILASTER, FIXED EA END

## ANALYSIS CONTROL CARD

TYPE OF SOLUTION.....	1
EQ. 0, DEFAULTS TO 1	
EQ. 1, NEWMARK-BETA METHOD	
EQ. 2, WILSON-THETA METHOD	
NUMBER OF LOAD CASES.....	1
TIME STEP.....	0.0500
TIME LIMIT.....	100.0000
NEWMARK*S GAMMA.....	0.0000
EQ. 0.0, DEFAULTS TO 0.5	
NEWMARK*S BETA.....	0.0000
EQ. 0.0, DEFAULTS TO 0.25	
WILSON*S THETA.....	0.0000
EQ. 0.0, DEFAULTS TO 1.4	
PRINT OPTION.....	-1
EQ. 0, DEFAULTS TO 1	
EQ. 1, PRINT EVERY STEP	
EQ. N, PRINT EVERY N-TH STEP	
EQ. -1, PRINT SIGNIFICANT CHANGES	

## INITIAL CONDITIONS

INITIAL DEFLECTION.....	0.0000
INITIAL VELOCITY.....	0.0000
INITIAL ACCELERATION.....	0.0000

## STIFFNESS CONTROL CARD

NUMBER OF STIFFNESSES.....	2
NUMBER OF REBOUND STIFFNESSES.....	2
MASS.....	9705.6000
PERCENT OF CRITICAL DAMPING.....	0.0100

## INITIAL RESISTANCE-DEFLECTION CURVE

NUMBER FRAC	MODE	STIFFNESS	RESISTANCE	YLD DEFL	MASS FACT	DAMP
1.00	1	0.15663E+04	0.22373E+03	0.00000E+00	1.00	
0.00	2	0.00000E+00	0.00000E+00	0.10000E+02	1.00	

## REBOUND RESISTANCE-DEFLECTION CURVE

NUMBER FRAC	MODE	STIFFNESS	RESISTANCE	YLD DEFL	MASS FACT	DAMP
	3	0.15663E+04-0.22373E+03	0.00000E+00		1.00	

1.00  
 0.00 4 3 0.00000E+00 0.00000E+00-0.10000E+02 1.00

# LOAD DATA

LOAD CASE NUMBER..... 1  
 NUMBER OF LOAD POINTS..... 5

POINT	TIME	LOAD
1	0.0000	152.0000
2	3.6000	334.8600
3	24.6200	205.1000
4	29.7500	0.0000
5	40.0000	0.0000

## GENERATED RESISTANCE - DEFLECTION CURVES

NATURAL PERIOD..... 15.6404

NUMBER	MODE	STIFFNESS	RESISTANCE	YLD DEFL	MASS FACT	DAMP
FRAC						
1	1	0.15663E+04	0.22373E+03	0.14284E+00	1.00	
2	3	0.00000E+00	0.22373E+03	0.10000E+02	1.00	
3	1	0.15663E+04	-0.22373E+03	-0.14284E+00	1.00	
4	3	0.00000E+00	-0.22373E+03	-0.10000E+02	1.00	

1\* \* \* \* NEWMARK-BETA SOLUTION \* \* \* \* \*

LOAD CASE..... 1  
 TIME STEP..... 0.0500

## \* \* \* \* \* SOLUTION RESULTS \* \* \* \* \*

LOAD	STEP	TIME	STIF	DEFLECTION	VELOCITY	ACC	RESISTANCE
ELAS	0	0.0000	1	0.000	0.0000	0.0157	0.00
152.00							
*CHG	79	3.9251	2	0.143	0.0704	0.0107	223.72
332.85							
REB	685	34.2500	1	4.034	-0.0009	-0.0230	223.70
0.00							
*CHG	763	38.1448	3	3.891	-0.0565	0.0005	0.00
0.00							
RLOD	841	42.0500	3	3.753	0.0004	0.0223	-216.80
0.00							
*CHG	920	45.9657	1	3.891	0.0547	-0.0004	0.00
0.00							
REB	998	49.9000	1	4.025	-0.0011	-0.0216	210.06
0.00							
*CHG	1076	53.7865	3	3.891	-0.0530	0.0004	0.00
0.00							
RLOD	1154	57.7000	3	3.761	0.0006	0.0210	-203.59
0.00							
*CHG	1233	61.6074	1	3.891	0.0514	-0.0004	0.00



0.00							
REB	1310	65.5000	1	4.017	-0.0001	-0.0203	197.31
0.00							
*CHG	1389	69.4282	3	3.891	-0.0498	0.0004	0.00
0.00							
RLOD	1467	73.3500	3	3.769	0.0007	0.0197	-191.18
0.00							
*CHG	1545	77.2491	1	3.891	0.0483	-0.0004	0.00
0.00							
REB	1623	81.1500	1	4.010	-0.0003	-0.0191	185.29
0.00							
*CHG	1702	85.0700	3	3.891	-0.0468	0.0004	0.00
0.00							
RLOD	1780	89.0000	3	3.777	0.0008	0.0185	-179.53
0.00							
*CHG	1858	92.8908	1	3.891	0.0453	-0.0004	0.00
0.00							
REB	1936	96.8000	1	4.002	-0.0004	-0.0179	174.00
0.00							

\*\*\*\*\* TIME LIMIT REACHED

MAXIMUM DEFLECTION IN SOLUTION

STEP NUMBER.....	684
TIME AT MAXIMUM.....	34.2000
MAXIMUM DEFLECTION.....	4.034

MINIMUM DEFLECTION IN SOLUTION

STEP NUMBER.....	840
TIME AT MINIMUM.....	42.0000
MINIMUM DEFLECTION.....	3.753

SOLUTION TIME LOG

ASSEMBLY.....	0.05
SDOF SOLUTION. (LOAD CASE 1)...	0.06

TOTAL TIME.....	0.11
-----------------	------

1ONE DEGREE OF FREEDOM SOLVER INPUT  
VERSION 2.2 FEB 1989

PROBLEM DESCRIPTION  
STOP

\*\*\*\*\* END SOLVER RUNS \*\*\*\*\*

$$\text{Allowable Defl } \Delta_x = \frac{25 \times 12}{2} \times \tan 2^\circ = 5.24'' > 4.03''$$

Pilast 9

SOLVER Program

```

SOLVE ANALYSIS OF 36" x 60" x 25.16' PILASTER, FIXED and SIMPLE
SUPPORT
  1      1      .05      200      -1
      2      2      9975.20      0.01
      1      815.60      167.80      1.0      1.0
      3      0.0      100      1.0      0.0
      1      815.60      -167.80      1.0      1.0
      3      0.0      -100      1.0      0.0
      1      5
      0.0      152      3.60      334.86      24.62      205.1      29.75
0.0
      40.0      0.0
STOP

```

This data file was used to determine the effect on Pilaster Deflection of Using one fixed and one simple support.

$\Delta_x$  increased from 4.03" up to 7.97"

$\Delta_x = 7.97"$  equates to a support Rotation of  $3^\circ$

*Pilast 9. out*  
*SOLVER Output*

1ONE DEGREE OF FREEDOM SOLVER INPUT  
VERSION 2.2 FEB 1989

PROBLEM DESCRIPTION  
SOLVE ANALYSIS OF 36" x 60" x 25.16' PILASTER, FIXED and SIMPLE  
SUPPORT

#### ANALYSIS CONTROL CARD

TYPE OF SOLUTION.....	1
EQ. 0, DEFAULTS TO 1	
EQ. 1, NEWMARK-BETA METHOD	
EQ. 2, WILSON-THETA METHOD	
NUMBER OF LOAD CASES.....	1
TIME STEP.....	0.0500
TIME LIMIT.....	200.0000
NEWMARK*S GAMMA.....	0.0000
EQ. 0.0, DEFAULTS TO 0.5	
NEWMARK*S BETA.....	0.0000
EQ. 0.0, DEFAULTS TO 0.25	
WILSON*S THETA.....	0.0000
EQ. 0.0, DEFAULTS TO 1.4	
PRINT OPTION.....	-1
EQ. 0, DEFAULTS TO 1	
EQ. 1, PRINT EVERY STEP	
EQ. N, PRINT EVERY N-TH STEP	
EQ. -1, PRINT SIGNIFICANT CHANGES	

#### INITIAL CONDITIONS

INITIAL DEFLECTION.....	0.0000
INITIAL VELOCITY.....	0.0000
INITIAL ACCELERATION.....	0.0000

#### STIFFNESS CONTROL CARD

NUMBER OF STIFFNESSES.....	2
NUMBER OF REBOUND STIFFNESSES.....	2
MASS.....	9975.2000
PERCENT OF CRITICAL DAMPING.....	0.0100

#### INITIAL RESISTANCE-DEFLECTION CURVE

NUMBER FRAC	MODE	STIFFNESS	RESISTANCE	YLD DEFL	MASS FACT	DAMP
1.00	1	0.81560E+03	0.16780E+03	0.00000E+00	1.00	
0.00	2	0.00000E+00	0.00000E+00	0.10000E+03	1.00	

#### REBOUND RESISTANCE-DEFLECTION CURVE

NUMBER FRAC	MODE	STIFFNESS	RESISTANCE	YLD DEFL	MASS FACT	DAMP
----------------	------	-----------	------------	----------	-----------	------

1.00	3	1	0.81560E+03-0.16780E+03	0.00000E+00	1.00
0.00	4	3	0.00000E+00 0.00000E+00-0.10000E+03		1.00

LOAD DATA

LOAD CASE NUMBER..... 1  
NUMBER OF LOAD POINTS..... 5

POINT	TIME	LOAD
1	0.0000	152.0000
2	3.6000	334.8600
3	24.6200	205.1000
4	29.7500	0.0000
5	40.0000	0.0000

GENERATED RESISTANCE - DEFLECTION CURVES

NATURAL PERIOD..... 21.9736

NUMBER	MODE	STIFFNESS	RESISTANCE	YLD DEFL	MASS FACT	DAMP
1.00	1	1	0.81560E+03 0.16780E+03	0.20574E+00	1.00	
0.00	2	3	0.00000E+00 0.16780E+03	0.10000E+03	1.00	
1.00	3	1	0.81560E+03-0.16780E+03-0.20574E+00		1.00	
0.00	4	3	0.00000E+00-0.16780E+03-0.10000E+03		1.00	

1\* \* \* \* \* NEWMARK-BETA SOLUTION \* \* \* \* \*

LOAD CASE..... 1  
TIME STEP..... 0.0500

\* \* \* \* \* SOLUTION RESULTS \* \* \* \* \*

LOAD	STEP	TIME	STIF	DEFLECTION	VELOCITY	ACC RESISTANCE
ELAS	0	0.0000	1	0.000	0.0000	0.0152 0.00
152.00						
*CHG	91	4.5287	2	0.206	0.0931	0.0156 167.80
329.13						
REB	904	45.2000	1	7.970	-0.0003	-0.0168 167.80
0.00						
*CHG	1015	50.7108	3	7.764	-0.0579	0.0003 0.00
0.00						
RLOD	1124	56.2000	3	7.565	0.0005	0.0163 -162.61
0.00						
*CHG	1234	61.6983	1	7.764	0.0561	-0.0003 0.00
0.00						
REB	1344	67.2000	1	7.957	-0.0007	-0.0158 157.57
0.00						
*CHG	1454	72.6859	3	7.764	-0.0544	0.0003 0.00
0.00						
RLOD	1563	78.1500	3	7.577	0.0001	0.0153 -152.71
0.00						

*CHG	1674	83.6734	1	7.764	0.0527	-0.0003	0.00
0.00							
REB	1783	89.1500	1	7.946	-0.0003	-0.0148	147.99
0.00							
*CHG	1894	94.6610	3	7.764	-0.0511	0.0003	0.00
0.00							
RLOD	2003	100.1500	3	7.588	0.0004	0.0144	-143.40
0.00							
*CHG	2113	105.6485	1	7.764	0.0495	-0.0003	0.00
0.00							
REB	2223	111.1500	1	7.935	-0.0006	-0.0139	138.96
0.00							
*CHG	2333	116.6361	3	7.764	-0.0480	0.0003	0.00
0.00							
RLOD	2442	122.1000	3	7.599	0.0001	0.0135	-134.68
0.00							
*CHG	2553	127.6237	1	7.764	0.0465	-0.0003	0.00
0.00							
REB	2662	133.1000	1	7.924	-0.0002	-0.0131	130.51
0.00							
*CHG	2773	138.6112	3	7.764	-0.0450	0.0003	0.00
0.00							
RLOD	2882	144.1000	3	7.609	0.0004	0.0127	-126.47
0.00							
*CHG	2992	149.5988	1	7.764	0.0436	-0.0002	0.00
0.00							
REB	3102	155.1000	1	7.914	-0.0005	-0.0123	122.55
0.00							
*CHG	3212	160.5863	3	7.764	-0.0423	0.0002	0.00
0.00							
RLOD	3321	166.0500	3	7.619	0.0001	0.0119	-118.77
0.00							
*CHG	3432	171.5739	1	7.764	0.0410	-0.0002	0.00
0.00							
REB	3541	177.0500	1	7.905	-0.0002	-0.0115	115.10
0.00							
*CHG	3652	182.5615	3	7.764	-0.0397	0.0002	0.00
0.00							
RLOD	3761	188.0500	3	7.627	0.0003	0.0112	-111.54
0.00							
*CHG	3871	193.5490	1	7.764	0.0385	-0.0002	0.00
0.00							
REB	3981	199.0500	1	7.897	-0.0005	-0.0108	108.08
0.00							

\*\*\*\*\* TIME LIMIT REACHED

#### MAXIMUM DEFLECTION IN SOLUTION

STEP NUMBER.....	903
TIME AT MAXIMUM.....	45.1500
MAXIMUM DEFLECTION.....	7.970

#### MINIMUM DEFLECTION IN SOLUTION

STEP NUMBER.....	1123
TIME AT MINIMUM.....	56.1500
MINIMUM DEFLECTION.....	7.565

#### SOLUTION TIME LOG

ASSEMBLY.....	0.05
---------------	------

```
SDOF SOLUTION.(LOAD CASE 1)...      0.11
TOTAL TIME.....                     0.16
1ONE DEGREE OF FREEDOM SOLVER INPUT
VERSION 2.2  FEB 1989

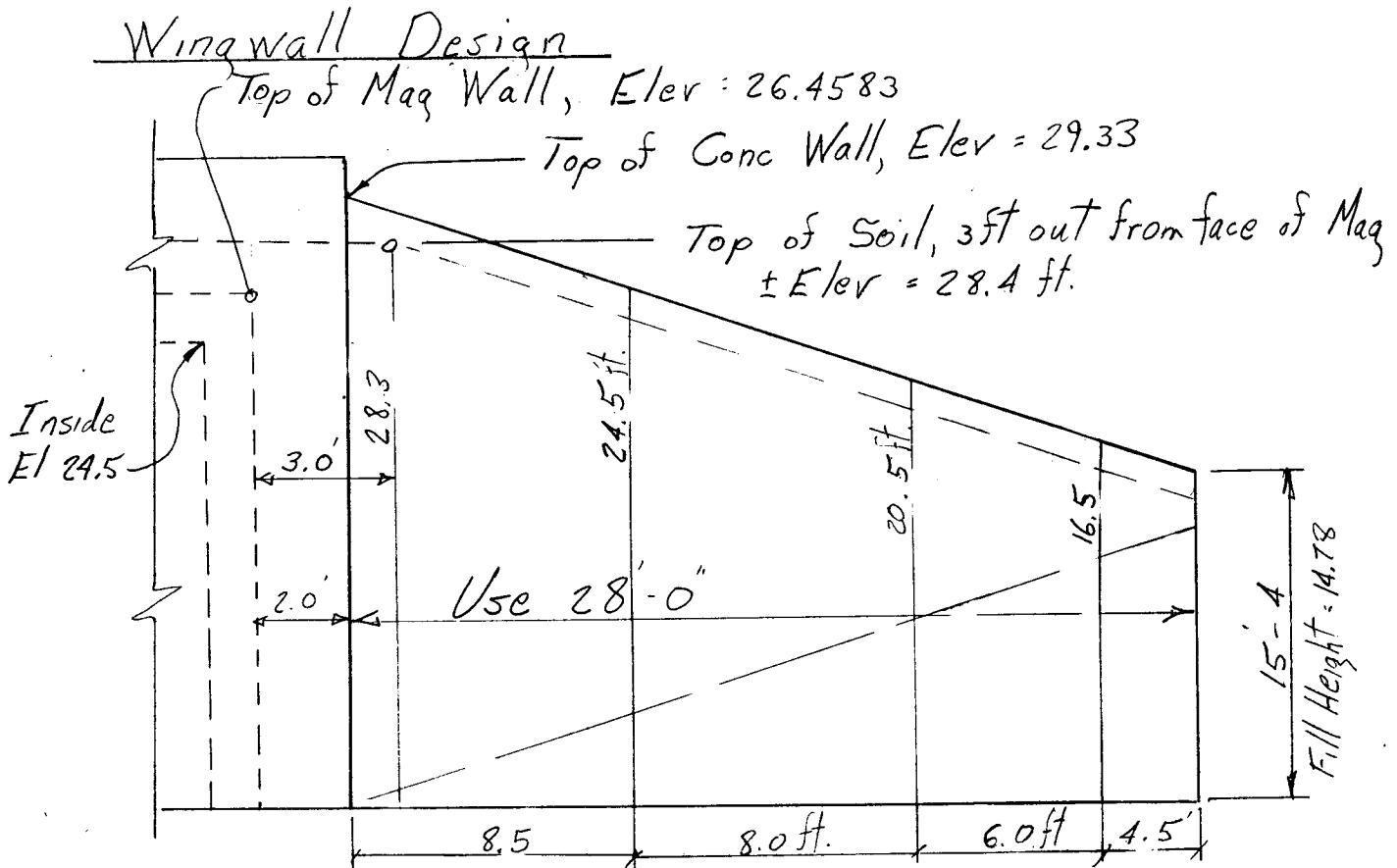
PROBLEM DESCRIPTION
STOP

***** END SOLVER RUNS *****
```

Project \_\_\_\_\_ Location \_\_\_\_\_  
Subject \_\_\_\_\_

# FRONT WING WALLS

Project P-501, ADCAP Magazines Location NWS Yorktown, VA  
Subject Wingwall Design



Top of Soil Elev = 28.42

Slope Length @ 2:1 =  $28.42 \times 2 = 56.84$  feet

Length of Wall:  $\frac{56.84 - 1.25 + 1.0}{2} = 28.3$  ft.

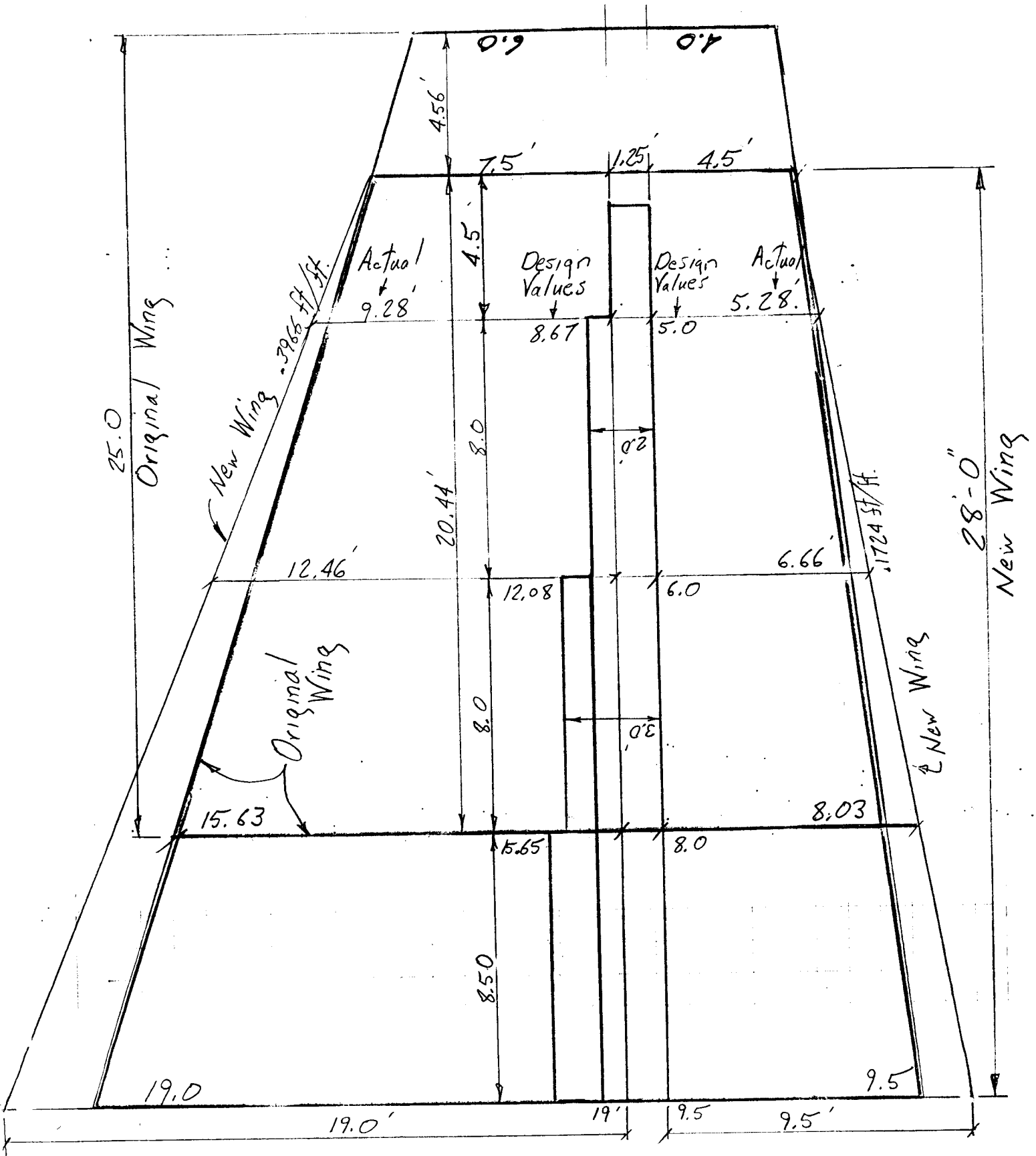
Height @ End of Wingwall  $\frac{28.3 + 1.25}{2} + 0.5 = 15'-4$

P501-28.WQ1



Project \_\_\_\_\_ Location \_\_\_\_\_

Subject \_\_\_\_\_



PAGE:

PROJECT: P-501, ADCAP Magazines

SUBJECT: \_\_\_\_\_

DATE: 11/17/98 BY: TA

# ----- RETAINING WALL DESIGN -----

&gt; DESCRIPTION : P-501, WINGWALL - 28.3 FT EARTH HEIGHT

## &gt; DESIGN DATA :

Soil Bearing Pressur	3,500 psf	FOOTING :	
Active Fluid Pressur	72 pcf	Ftg/Soil Friction	= 0.45
Passive Pressure =	60 pcf	f'c - Concrete	= 4,000 psi
Soil Density =	120 pcf	Fy - Reinforcement	= 60,000 psi

## &gt; WALL LOADING CONDITIONS

Slope of Backfill	0 : 1	Design Fluid Pressure =	72.0 pcf
(horiz:vert, 0=Level)		(Corrected for Slope)	
Surcharge over Toe =	0 psf	Surcharge over Heel =	200 psf
Shall Surcharge be used in Resisting Moment?	Y=1, N=0		0 <--
Soil Ht. over Toe =	0 in	Axial Load on Stem =	0 plf
Wall Ht. above Soil	0.5 ft	Load @ Wall Above Soil =	0 psf
ADJACENT FOOTING LOAD :		Width of Footing =	0 ft
Footing Load =	0 plf	Ftg. Dist. from Wall =	0 ft
Spread Footing ?		Depth of Bearing Below	
Y=1, N=0 : -->	0	Soil @ Rear F.O.W. =	0 ft
UNIFORM LOAD (Added) =	0 plf	Bottom Above T.O.F. =	0.00 ft
		Top Above T.O.F. =	0.00 ft

## WALL &amp; FOOTING GEOMETRY

> RETAINED HEIGHT =	28.3 ft	> Footing Thickness =	36 in
(above T.O.F.)			
> Toe Width =	9.5 ft	> Key Depth =	0 in
Stem Width =	3.50 ft	> Key Width =	0 in
> Heel Width =	16.75 ft	> Toe / Key Dist. =	0 ft
FOOTING WIDTH =	29.75 ft		

## STABILITY SUMMARY

SOIL PRESSURE @ TOE = 3,242 psf : 3,500 = Allow  
 SOIL PRESSURE @ HEEL = 2,087 psf

FACTOR OF SAFETY: Overturning = 3.54  
 FACTOR OF SAFETY: Sliding = 0.92

NOTE:

ONE-WAY SHEAR AT TOE SIDE OF STEM = < 0 > 1 = OK  
 ONE - WAY SHEAR AT HEEL SIDE OF STEM = 1 > 0 = NO GOOD

## STABILITY CHECK

> NOTE: Should 1/3 of Active Pressure be used as Vertical Pressure at rear face of Stem? Y=1, N=0 ---> 0

OVERTURNING MOMENT = 426,753 ft-#  
 RESISTING MOMENT = \*\*\*\*\*ft-# MAX. LATERAL FORCE = 39,025 #

FACTOR OF SAFETY: Overturning --> 3.54

## SLIDING CHECK

Max. Lateral Force = 39,025 # > Ht. of Soil to Neglect = 0.00 in  
 Max. Resisting Force 35,942 # Passive Pressure = 270 #  
 F.S. : Sliding = 0.92 Friction Pressure = 35,672 #

## SOIL PRESSURE

Eccentricity from CL = 1.07 ft Kern Distance = 4.96 ft

UN-FACTORED FACTORED

----> SOIL PRESSURE @ TOE = 3,242 psf 5,406 psf  
 ----> SOIL PRESSURE @ HEEL = 2,087 psf 2,054 psf

## TOE DESIGN

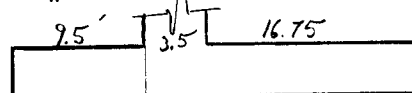
Mu'' = Upward = 227860 ft-# Mu : DESIGN MOMENT = 200379 ft-#  
 Mu' = Downward = 27481.1 ft-#  
 > % Steel Minimum = 0.0012 Rebar Cover 3.5 in  
 As : Required = 1.415 in^2/ft d = Thk - Cover 32.50 in  
 As : Provided = 1.415 in^2/ft 'm' = 17.65  
 R-u = 210.79 psi

One Way Shear :  
 Fv = 2\*(f'c ^ .5) = 126.49 psi  
 Actual Shear / Phi = 139.60 psi

Try: 1.5 " #7 @ 5.5 "  
 #5 @ 2.5 " #8 @ 6.5 "  
 #6 @ 3.5 " #9 @ 8.5 "

## HEEL DESIGN

$v_u = \frac{46,275}{32.5 \times 12 \times .85} = 139.6$  c Face of Wall  
 $v_u @ d = \frac{46,275 - 2.7(4336)}{32.5 \times 12 \times .85} = 104.3$  psi < 126.5 OK



2054 psf

4336  
 1070  
 5-11-2

```

-----
> Neglect Upward Soil Pressure?  Y=1, N=0          1
-----
Mu' '= Downward Mom.  755330 ft-#      Mu : DESIGN MOMENT = 755330 ft-#
Mu' =Upward Mom. = 0 ft-#
Rebar Cover = 3.6 in
> % Steel Minimum = 0.0012      d = Thk-Cover = 32.40 in
As : Required = 5.997 in^2/ft      "m" = 17.65
As : Provided = 5.997 in^2/ft      R-u = 799.47 psi

One Way Shear :
Fv = 2*(f'c ^ .5) = 126.49 psi      Try: 0.50 " #7 @ 1.50 "
Actual Shear / Phi 53.12 psi          #5 @ 0.50 " #8 @ 1.50 "
                                         #6 @ 0.50 " #9 @ 2.50 "

```

#### TOP STEM SECTION DESIGN

```

-----
> WALL MATERIAL : CONCRETE = 1, MASONRY = 2          1 <<--
-----
> f'm - Masonry 0 psi > Bottom Ht. above T.O.F. 16 ft
> Fs : for Masonry 0 psi Loaded Section Height 12.80 ft
> f'c - Concrete 4,000 psi
> Fy : for Concrete 60,000 psi Total Lateral Press. = 6922.4 #
> Load Factor 1.00 Maximum Ms:Service = 31408 ft-#
> Grouting? Y=1 N=0 > 0
> Inspected ? Y=1, N 0 > WALL THICKNESS = 15 in
> Center=1, Edge=2 -- 2
> REBAR SIZE 8
Masonry : Actual Allow. REQ'D SPACING = 10.00 in
f'm = ERR NA psi Rebar Area Supplied = 0.89 in^2
fs = ERR NA psi 'd' for design = 13.00 in
Bond Length Req'd = NA in Allowable Unit Shear 126.5 psi
Actual Unit Shear 75.4 psi

```

#### 2nd TOP STEM SECTION DESIGN

```

-----
> WALL MATERIAL : CONCRETE = 1, MASONRY = 2          1 <<--
-----
> f'm - Masonry 0 psi > Bottom Ht. above T.O.F. 8 ft
> Fs : for Masonry 0 psi Loaded Section Height 20.80 ft
> f'c - Concrete 4,000 psi
> Fy : for Concrete 60,000 psi Total Lateral Press. = 17271 #
> Load Factor 1.00 Maximum Ms:Service = 125111 ft-#
> Grouting? Y=1 N=0 > 0
> Inspected ? Y=1, N 0 > WALL THICKNESS = 24 in
> Center=1, Edge=2 -- 2
> REBAR SIZE 10
Masonry : Actual Allow. REQ'D SPACING = 6.50 in
f'm = ERR NA psi Rebar Area Supplied = 2.33 in^2
fs = ERR NA psi 'd' for design = 22.00 in
Bond Length Req'd = NA in Allowable Unit Shear 126.5 psi
Actual Unit Shear 111.2 psi

```

#### 3rd TOP STEM SECTION DESIGN

```

-----
> WALL MATERIAL : CONCRETE = 1, MASONRY = 2          1 <<--
-----
> f'm - Masonry 0 psi > Bottom Ht. above T.O.F. 0 ft
> Fs : for Masonry 0 psi Loaded Section Height 28.80 ft

```

> f'c - Concrete	4,000	psi			
> Fy : for Concrete	60,000	psi	Total Lateral Press.	=	32228 #
> Load Factor	1.00		Maximum Ms:Service	=	320036 ft-#
> Grouting? Y=1 N=0	>	0			
> Inspected ? Y=1, N		0	> WALL THICKNESS	=	42
> Center=1, Edge=2	--	2			
Masonry :	Actual	Allow.	> REBAR SIZE		11
f'm =	NA	NA psi	REQ'D SPACING	=	5.75 in
fs =	NA	NA psi	Rebar Area Supplied	=	3.21 in^2
Bond Length Req'd =		NA in	'd' for design	=	40.00 in
			Allowable Unit Shear		126.5 psi
			Actual Unit Shear		114.1 psi

P501-28.wg3

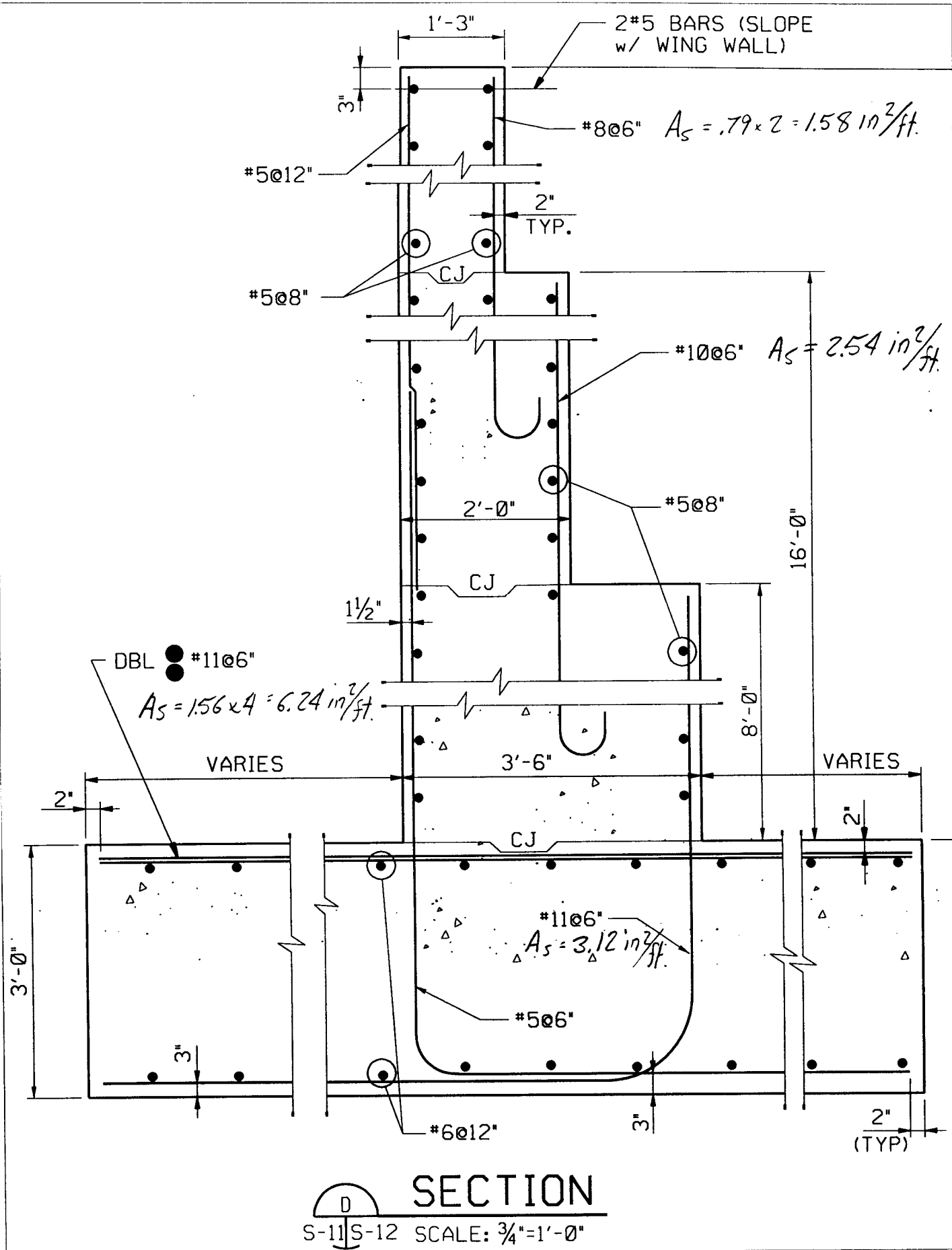
28.3 ft Earth Height

## RESISTING MOMENT TAKEN ABOUT TOE :

Taking Moments About Toe :	Weight (Lbs)	Moment Arm (ft)	Resisting Moment	Moment About Heel To Calc Soil Pressure		Fact -Load--
				Arm	Moment	
Soil Wt. over Heel	=40,866	17.95	733,545	6.95	284,019	57212.4
Soil Wt. over Toe	= 0	0.00	0	20.90	0	0
Wt of Sloped Soil	= 0	20.27	0	4.63	0	0
Surcharge @ Toe	= 0	4.00	0	20.90	0	0
Surcharge @ Heel	= 0	17.95	0	6.95	0	0
Wt from Adjacent Ftg.	= 0	0.00	0	23.46	0	0
Top Stem Section Wt	= 1,688	8.63	14,555	14.53	24,511	2362.5
Middle Stem Section Wt	= 2,400	9.00	21,600	14.90	35,760	3360
Bottom Stem Section Wt	= 3,600	9.50	34,200	15.40	55,440	5040
EFB over Toe	= 0.00	3.00	0	0.00	0.00	0
Axial Load on Stem	= 0	9.50	0	15.40	0	0
Footing Weight	=11,205	12.45	139,502	12.45	139,502	15687
Key Weight	= 0	0.00	0	24.90	0	0

Force on Projecting Stem	= 0.00	0.00	0.00	27.75	0	0
Passive Soil Pressure	= 0	0.00	0	13.90	0	0

Total Vertical Load #	=59,759	Sum Mom	943,402	59,759	539,232	83661.9
Total Moment on Footing	=*****ft-# ( To determine soil pressure)					



PROJECT: P-501, ADCAP Magazines  
 SUBJECT: Wingwall Design

DATE: 11/18/98 BY: TA

# -----

## RETAINING WALL DESIGN

# -----

> DESCRIPTION : P-501, WINGWALL - 24.5 FT EARTH HEIGHT

### > DESIGN DATA :

Soil Bearing Pressur	3,500 psf	FOOTING :	
Active Fluid Pressur	72 pcf	Ftg/Soil Friction	= 0.45
Passive Pressure =	60 pcf	f'c - Concrete	= 4,000 psi
Soil Density =	120 pcf	Fy - Reinforcement	= 60,000 psi

### > WALL LOADING CONDITIONS

Slope of Backfill	0 : 1	Design Fluid Pressure =	72.0 pcf
(horiz:vert, 0=Level)		(Corrected for Slope)	

Surcharge over Toe =	0 psf	Surcharge over Heel =	200 psf
Shall Surcharge be used in Resisting Moment?	Y=1, N=0		0 <--

Soil Ht. over Toe =	0 in	Axial Load on Stem =	0 plf
---------------------	------	----------------------	-------

Wall Ht. above Soil	0.5 ft	Load @ Wall Above Soil =	0 psf
---------------------	--------	--------------------------	-------

ADJACENT FOOTING LOAD :		Width of Footing =	0 ft
Footing Load =	0 plf	Ftg. Dist. from Wall =	0 ft
Spread Footing ?		Depth of Bearing Below	
Y=1, N=0 : -->	0	Soil @ Rear F.O.W. =	0 ft

UNIFORM LOAD (Added) =	0 plf	Bottom Above T.O.F. =	0.00 ft
		Top Above T.O.F. =	0.00 ft

### WALL & FOOTING GEOMETRY

> RETAINED HEIGHT =	24.5 ft	> Footing Thickness =	36 in
(above T.O.F.)			

> Toe Width =	8 ft	> Key Depth =	0 in
Stem Width =	3.00 ft	> Key Width =	0 in
> Heel Width =	13.9 ft	> Toe / Key Dist. =	0 ft

FOOTING WIDTH = 24.90 ft



# STABILITY SUMMARY

SOIL PRESSURE @ TOE = 3,273 psf : 3,500 = Allow  
 SOIL PRESSURE @ HEEL = 1,527 psf

FACTOR OF SAFETY: Overturning = 3.20  
 FACTOR OF SAFETY: Sliding = 0.89

## NOTE:

ONE-WAY SHEAR AT TOE SIDE OF STEM = < 1 > 1 = OK  
 ONE - WAY SHEAR AT HEEL SIDE OF STEM = 1 > 0 = NO GOOD

# STABILITY CHECK

> NOTE: Should 1/3 of Active Pressure be used as Vertical Pressure at rear face of Stem? Y=1, N=0 --->> 0

OVERTURNING MOMENT = 294,938 ft-#  
 RESISTING MOMENT = 943,402 ft-# MAX. LATERAL FORCE = 30,525 #

FACTOR OF SAFETY: Overturning --> 3.20

# SLIDING CHECK

Max. Lateral Force = 30,525 # > Ht. of Soil to Neglect = 0.00 in  
 Max. Resisting Force 27,161 # Passive Pressure = 270 #  
 F.S. : Sliding = 0.89 Friction Pressure = 26,891 #

# SOIL PRESSURE

Eccentricity from CL = 1.51 ft Kern Distance = 4.15 ft

UN-FACTORED FACTORED

-----> SOIL PRESSURE @ TOE = 3,273 psf 5,438 psf  
 -----> SOIL PRESSURE @ HEEL = 1,527 psf 1,282 psf

# TOE DESIGN

Mu'' = Upward = 159770 ft-# Mu : DESIGN MOMENT = 140282 ft-#  
 Mu' = Downward = 19488 ft-#  
 > % Steel Minimum = 0.0012 Rebar Cover 3.5 in  
 As : Required = 0.981 in^2/ft d = Thk - Cover 32.50 in  
 As : Provided = 0.981 in^2/ft 'm' = 17.65  
 R-u = 147.57 psi  
 One Way Shear : Try: 2.5 " #7 @ 7.5 "  
 Fv = 2\*(f'c ^ .5) = 126.49 psi #5 @ 3.5 " #8 @ 9.5 "  
 Actual Shear / Phi = 115.12 psi #6 @ 5.5 " #9 @ 12.5 "

# HEEL DESIGN

> Neglect Upward Soil Pressure? Y=1, N=0

---  
1  
---

Mu' = Downward Mom. 458487 ft-# Mu : DESIGN MOMENT = 458487 ft-#  
Mu' = Upward Mom. = 0 ft-#

> % Steel Minimum = 0.0012 Rebar Cover = 2 in  
d = Thk-Cover = 34.00 in  
As : Required = 3.221 in<sup>2</sup>/ft "m" = 17.65  
As : Provided = 3.221 in<sup>2</sup>/ft R-u = 440.68 psi

One Way Shear : Try: 0.50 " #7 @ 2.50 "  
Fv = 2\*(f'c ^ .5) = 126.49 psi #5 @ 1.50 " #8 @ 2.50 "  
Actual Shear / Phi 46.02 psi #6 @ 1.50 " #9 @ 3.50 "

#### TOP STEM SECTION DESIGN

> WALL MATERIAL : CONCRETE = 1, MASONRY = 2

---  
1 <<--  
---

> f'm - Masonry 0 psi > Bottom Ht. above T.O.F. 16 ft  
> Fs : for Masonry 0 psi Loaded Section Height 9.00 ft  
> f'c - Concrete 4,000 psi  
> Fy : for Concrete 60,000 psi Total Lateral Press. = 3621 #  
> Load Factor 1.00 Maximum Ms:Service = 11705 ft-#  
> Grouting? Y=1 N=0 > 0  
> Inspected ? Y=1, N 0 > WALL THICKNESS = 15 in  
> Center=1, Edge=2 -- 2

Masonry : Actual Allow. REQ'D SPACING = 10  
f'm = ERR NA psi Rebar Area Supplied = 32.00 in  
fs = ERR NA psi 'd' for design = 0.43 in<sup>2</sup>  
Bond Length Req'd = NA in Allowable Unit Shear = 13.00 in  
126.5 psi

Actual Unit Shear 39.5 psi

#### 2nd TOP STEM SECTION DESIGN

> WALL MATERIAL : CONCRETE = 1, MASONRY = 2

---  
1 <<--  
---

> f'm - Masonry 0 psi > Bottom Ht. above T.O.F. 8 ft  
> Fs : for Masonry 0 psi Loaded Section Height 17.00 ft  
> f'c - Concrete 4,000 psi  
> Fy : for Concrete 60,000 psi Total Lateral Press. = 11781 #  
> Load Factor 1.00 Maximum Ms:Service = 70241 ft-#  
> Grouting? Y=1 N=0 > 0  
> Inspected ? Y=1, N 0 > WALL THICKNESS = 24 in  
> Center=1, Edge=2 -- 2

Masonry : Actual Allow. REQ'D SPACING = 10  
f'm = ERR NA psi Rebar Area Supplied = 11.75 in  
fs = ERR NA psi 'd' for design = 1.26 in<sup>2</sup>  
Bond Length Req'd = NA in Allowable Unit Shear = 22.00 in  
126.5 psi  
Actual Unit Shear 75.9 psi

#### 3rd TOP STEM SECTION DESIGN

> WALL MATERIAL : CONCRETE = 1, MASONRY = 2

---  
1 <<--  
---

> f'm - Masonry 0 psi > Bottom Ht. above T.O.F. 0 ft  
> Fs : for Masonry 0 psi Loaded Section Height 25.00 ft  
> f'c - Concrete 4,000 psi

> Fy : for Concrete	60,000	psi	Total Lateral Press.	=	24549	#
> Load Factor	1.00		Maximum Ms:Service	=	212489	ft-#
> Grouting? Y=1 N=0	>	0				
> Inspected ? Y=1, N		0	> WALL THICKNESS	=	36	
> Center=1, Edge=2	--	2				
			> REBAR SIZE		10	
Masonry :	Actual	Allow.	REQ'D SPACING	=	6.00	in
f'm =	NA	NA	Rebar Area Supplied	=	2.50	in^2
fs =	NA	NA	'd' for design	=	34.00	in
Bond Length Req'd =		NA	Allowable Unit Shear		126.5	psi
			Actual Unit Shear		102.3	psi

24.5 ft of Earth Height

501RET.WQ1

RESISTING MOMENT TAKEN ABOUT TOE :

Taking Moments About Toe :	Weight (Lbs)	Moment Arm (ft)	Resisting Moment	Moment About Heel To Calc Soil Pressure		Fact -Load-
				---Arm---	---Moment---	
Soil Wt. over Heel	=41,160	17.00	699,720	7.00	288,120	57624
Soil Wt. over Toe	= 0	0.00	0	20.50	0	0
Wt of Sloped Soil	= 0	19.33	0	4.67	0	0
Surcharge @ Toe	= 0	3.50	0	20.50	0	0
Surcharge @ Heel	= 0	17.00	0	7.00	0	0
Wt from Adjacent Ftg.	= 0	0.00	0	23.46	0	0
Top Stem Section Wt	= 1,688	7.63	12,867	14.63	24,680	2362.5
Middle Stem Section Wt	= 2,400	8.00	19,200	15.00	36,000	3360
Bottom Stem Section Wt	= 3,600	8.50	30,600	15.50	55,800	5040
EFP over Toe	= 0.00	3.00	0	0.00	0.00	0
Axial Load on Stem	= 0	8.50	0	15.50	0	0
Footing Weight	=10,800	12.00	129,600	12.00	129,600	15120
Key Weight	= 0	0.00	0	24.00	0	0
Force on Projecting Stem	= 0.00	0.00	0.00	27.75	0	0
Passive Soil Pressure	= 0	0.00	0	14.00	0	0
<hr/>						
Total Vertical Load #	=59,648	Sum Mom	891,987	59,648	534,200	83506.5



PROJECT: P-501, ADCAP Magazines  
 SUBJECT: Wingwall Design

DATE: 11/17/98 BY: TA

# RETAINING WALL DESIGN

> DESCRIPTION : P-501, WINGWALL - 20.5 FT EARTH HEIGHT

## DESIGN DATA :

Soil Bearing Pressur	3,500 psf	FOOTING :	
Active Fluid Pressur	72 pcf	Ftg/Soil Friction	= 0.45
Passive Pressure =	60 pcf	f'c - Concrete	= 4,000 psi
Soil Density =	120 pcf	Fy - Reinforcement	= 60,000 psi

## WALL LOADING CONDITIONS

Slope of Backfill (horiz:vert, 0=Level)	0 :1	Design Fluid Pressure =	72.0 pcf (Corrected for Slope)
Surcharge over Toe =	0 psf	Surcharge over Heel =	200 psf
Shall Surcharge be used in Resisting Moment?	Y=1, N=0		0 <--
Soil Ht. over Toe =	0 in	Axial Load on Stem =	0 plf
Wall Ht. above Soil	0.5 ft	Load @ Wall Above Soil=	0 psf
ADJACENT FOOTING LOAD :		Width of Footing =	0 ft
Footing Load =	0 plf	Ftg. Dist. from Wall =	0 ft
Spread Footing ?		Depth of Bearing Below	
Y=1 , N=0 : -->	0	Soil @ Rear F.O.W. =	0 ft
UNIFORM LOAD (Added)=	0 plf	Bottom Above T.O.F. =	0.00 ft
		Top Above T.O.F. =	0.00 ft

## WALL & FOOTING GEOMETRY

> RETAINED HEIGHT =	20.5 ft	> Footing Thickness =	36 in
(above T.O.F.)		> Key Depth =	0 in
> Toe Width =	6 ft	> Key Width =	0 in
Stem Width =	2.00 ft	> Toe / Key Dist. =	0 ft
> Heel Width =	11.33 ft		
FOOTING WIDTH =	19.33 ft		

# STABILITY SUMMARY

SOIL PRESSURE @ TOE = 3,577 psf : 3,500 = Allow  
 SOIL PRESSURE @ HEEL = 707 psf  
 FACTOR OF SAFETY: Overturning = 2.64

FACTOR OF SAFETY: Sliding = 0.83

NOTE:  
 ONE-WAY SHEAR AT TOE SIDE OF STEM = < 1 > 1 = OK  
 ONE - WAY SHEAR AT HEEL SIDE OF STEM = 1 > 0 = NO GOOD

## STABILITY CHECK

> NOTE: Should 1/3 of Active Pressure be used as Vertical Pressure at rear face of Stem? Y=1, N=0 --->> 0

OVERTURNING MOMENT = 188,870 ft-#  
 RESISTING MOMENT = 497,888 ft-# MAX. LATERAL FORCE = 22,701 #

FACTOR OF SAFETY: Overturning --> 2.64

## SLIDING CHECK

Max. Lateral Force = 22,701 # > Ht. of Soil to Neglect = 0.00 in  
 Max. Resisting Force 18,904 # Passive Pressure = 270 #  
 F.S. : Sliding = 0.83 Friction Pressure = 18,634 #

## SOIL PRESSURE

Eccentricity from CL = 2.16 ft Kern Distance = 3.22 ft

	UN-FACTORED	FACTORED
SOIL PRESSURE @ TOE	3,577 psf	5,918 psf
SOIL PRESSURE @ HEEL	707 psf	80 psf

## TOE DESIGN

Mu'' = Upward = 95648.1 ft-# Mu : DESIGN MOMENT = 84686 ft-#  
 Mu' = Downward = 10962 ft-#  
 > % Steel Minimum = 0.0012  
 As : Required = 0.587 in^2/ft  
 As : Provided = 0.587 in^2/ft  
 One Way Shear :  
 Fv = 2\*(f'c ^ .5) = 126.49 psi  
 Actual Shear / Phi = 90.71 psi  
 Try:  
 #5 @ 4.5 " #7 @ 12.5 "  
 #6 @ 6.5 " #8 @ 16.5 "  
 #9 @ 8.5 " #9 @ 20.5 "

## HEEL DESIGN

```

> Neglect Upward Soil Pressure?  Y=1, N=0          1
Mu'' = Downward Mom.  261487 ft-#      Mu : DESIGN MOMENT = 261487 ft-#
Mu'  =Upward Mom.    =      0 ft-#
Rebar Cover           =      2 in
d = Thk-Cover         = 34.00 in
% Steel Minimum       = 0.0012

```

```

As : Required = 1.777 in^2/ft      "m"           = 17.65
As : Provided = 1.777 in^2/ft      R-u           = 251.33 psi

```

```

One Way Shear :      Try:  1.50 "    #7 @ 4.50 "
Fv = 2*(f'c ^ .5) = 126.49 psi    #5 @ 2.50 "    #8 @ 5.50 "
Actual Shear / Phi  43.09 psi    #6 @ 2.50 "    #9 @ 6.50 "

```

#### TOP STEM SECTION DESIGN

```

> WALL MATERIAL : CONCRETE = 1, MASONRY = 2          -      1      <<--
> f'm - Masonry      0 psi > Bottom Ht. above T.O.F.      8 ft
> Fs : for Masonry    0 psi Loaded Section Height    13.00 ft
> f'c - Concrete      4,000 psi
> Fy : for Concrete   60,000 psi Total Lateral Press. = 7125 #
> Load Factor        1.00 Maximum Ms:Service = 32813 ft-#
> Grouting? Y=1 N=0 > 0
> Inspected? Y=1, N 0
> Center=1, Edge=2 -- 2
> WALL THICKNESS = 15 in
> REBAR SIZE 10
Masonry : Actual Allow. REQ'D SPACING = 14.75 in
f'm = ERR NA psi Rebar Area Supplied = 0.93 in^2
fs = ERR NA psi 'd' for design = 13.00 in
Bond Length Req'd = NA in Allowable Unit Shear 126.5 psi
Actual Unit Shear 77.6 psi

```

#### 2nd TOP STEM SECTION DESIGN

```

> WALL MATERIAL : CONCRETE = 1, MASONRY = 2          -      1      <<--
> f'm - Masonry      0 psi > Bottom Ht. above T.O.F.      0 ft
> Fs : for Masonry    0 psi Loaded Section Height    21.00 ft
> f'c - Concrete      4,000 psi
> Fy : for Concrete   60,000 psi Total Lateral Press. = 17589 #
> Load Factor        1.00 Maximum Ms:Service = 128597 ft-#
> Grouting? Y=1 N=0 > 0
> Inspected? Y=1, N 0
> Center=1, Edge=2 -- 2
> WALL THICKNESS = 24 in
> REBAR SIZE 10
Masonry : Actual Allow. REQ'D SPACING = 6.25 in
f'm = ERR NA psi Rebar Area Supplied = 2.40 in^2
fs = ERR NA psi 'd' for design = 22.00 in
Bond Length Req'd = NA in Allowable Unit Shear 126.5 psi
Actual Unit Shear 113.3 psi

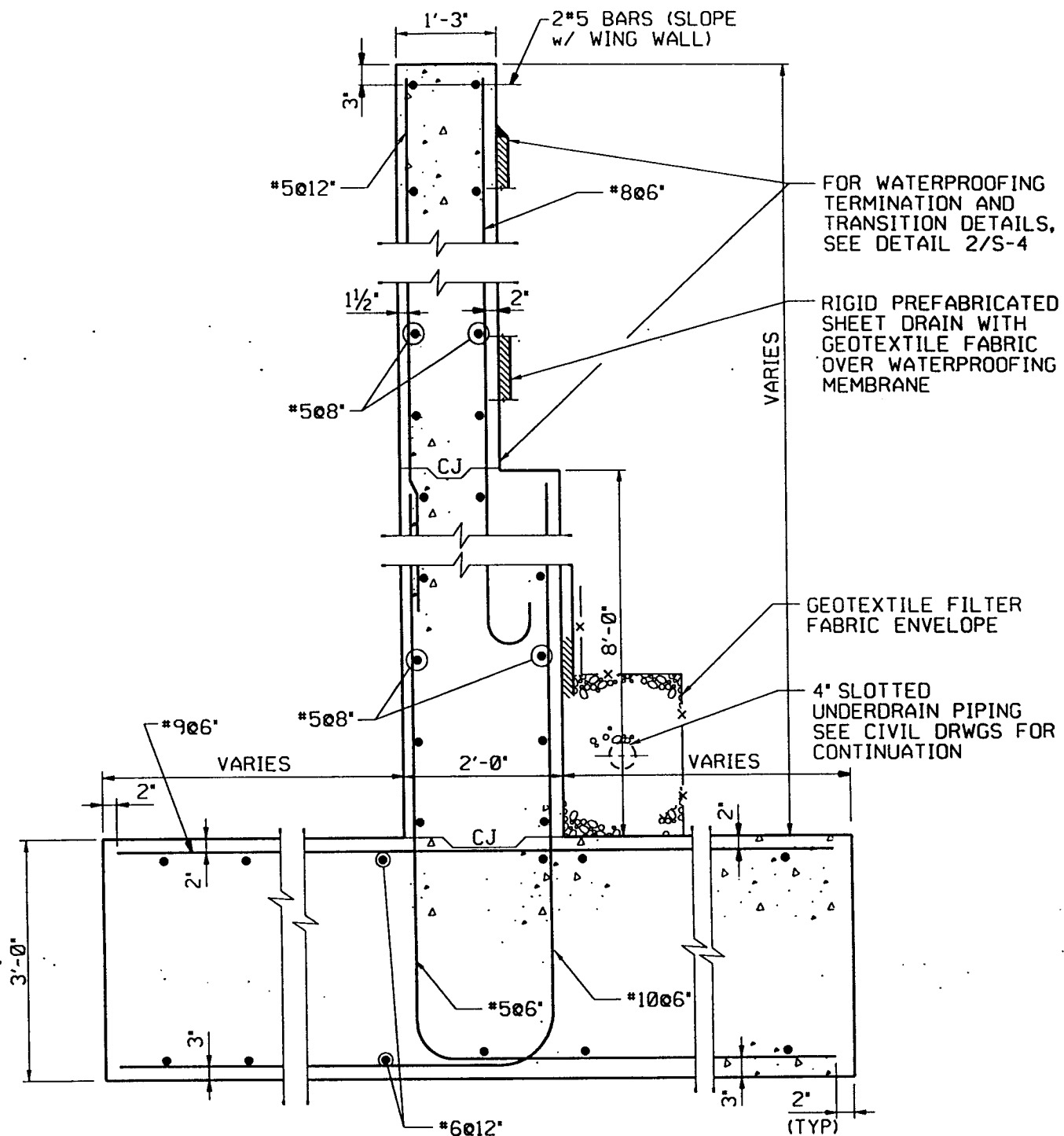
```



20.5 ft Earth Height

RESISTING MOMENT TAKEN ABOUT TOE :

Taking Moments About Toe :	Weight (Lbs)	Moment Arm (ft)	Resisting Moment	Moment About Heel To Calc Soil Pressure		Fact -Load-
				Arm	Moment	
Soil Wt. over Heel	=27,872	13.67	380,868	5.67	157,894	39020.5
Soil Wt. over Toe	= 0	0.00	0	16.33	0	0
Wt of Sloped Soil	= 0	15.55	0	3.78	0	0
Surcharge @ Toe	= 0	3.00	0	16.33	0	0
Surcharge @ Heel	= 0	13.67	0	5.67	0	0
Wt from Adjacent Ftg.	= 0	0.00	0	20.72	0	0
Top Stem Section Wt	= 2,438	6.63	16,148	11.96	29,140	3412.5
Middle Stem Section Wt	= 2,400	7.00	16,800	12.33	29,592	3360
Bottom Stem Section Wt	= 0	6.00	0	11.33	0	0
EFP over Toe	= 0.00	3.00	0	0.00	0.00	0
Axial Load on Stem	= 0	7.00	0	12.33	0	0
Footing Weight	= 8,699	9.67	84,071	9.67	84,071	12177.9
Key Weight	= 0	0.00	0	19.33	0	0
Force on Projecting Stem	= 0.00	0.00	0.00	23.75	0	0
Passive Soil Pressure	= 0	0.00	0	11.33	0	0
Total Vertical Load #	=41,408	Sum Mom	497,888	41,408	300,697	57970.9



SECTION  
 S-11 S-12 SCALE: 3/4"=1'-0"

PAGE:

PROJECT: P-501 ADCAP Magazines  
 SUBJECT: Wingwall Design

DATE: 11/17/98 BY: TA

# RETAINING WALL DESIGN

> DESCRIPTION : P-501, WINGWALL P-501, WINGWALL - 17.5 FT EARTH HEIGHT

## > DESIGN DATA :

Soil Bearing Pressur	3,500 psf	FOOTING :	
Active Fluid Pressur	72 pcf	Ftg/Soil Friction	= 0.45
Passive Pressure =	60 pcf	f'c - Concrete	= 4,000 psi
Soil Density =	120 pcf	Fy - Reinforcement	= 60,000 psi

## WALL LOADING CONDITIONS

Slope of Backfill (horiz:vert, 0=Level)	0 :1	Design Fluid Pressure =	72.0 pcf (Corrected for Slope)
Surcharge over Toe =	0 psf	Surcharge over Heel =	200 psf
Shall Surcharge be used in Resisting Moment?	Y=1, N=0		0 <--
Soil Ht. over Toe =	0 in	Axial Load on Stem =	0 plf
Wall Ht. above Soil	0.5 ft	Load @ Wall Above Soil =	0 psf
ADJACENT FOOTING LOAD :		Width of Footing =	0 ft
Footing Load =	0 plf	Ftg. Dist. from Wall =	0 ft
Spread Footing ?		Depth of Bearing Below	
Y=1, N=0 : -->	0	Soil @ Rear F.O.W. =	0 ft
UNIFORM LOAD (Added) =	0 plf	Bottom Above T.O.F. =	0.00 ft
		Top Above T.O.F. =	0.00 ft

## WALL & FOOTING GEOMETRY

> RETAINED HEIGHT =	16.7 ft	> Footing Thickness =	24 in
(above T.O.F.)		> Key Depth =	0 in
> Toe Width =	5 ft	> Key Width =	0 in
Stem Width =	1.25 ft	> Toe / Key Dist. =	0 ft
> Heel Width =	8.67 ft		
FOOTING WIDTH =	14.92 ft		

# STABILITY SUMMARY

SOIL PRESSURE @ TOE = 3,057 psf : 3,500 = Allow  
 SOIL PRESSURE @ HEEL = 304 psf

FACTOR OF SAFETY: Overturning = 2.37  
 FACTOR OF SAFETY: Sliding = 0.77

## NOTE:

ONE-WAY SHEAR AT TOE SIDE OF STEM = < 1 > 1 = OK  
 ONE - WAY SHEAR AT HEEL SIDE OF STEM = 1 > 0 = NO GOOD

## STABILITY CHECK

> NOTE: Should 1/3 of Active Pressure be used as Vertical  
 Pressure at rear face of Stem? Y=1, N=0 --->> 0

OVERTURNING MOMENT = 99,452 ft-#  
 RESISTING MOMENT = 235,443 ft-# MAX. LATERAL FORCE = 14,833 #

FACTOR OF SAFETY: Overturning --> 2.37

## SLIDING CHECK

Max. Lateral Force = 14,833 # > Ht. of Soil to Neglect = 0.00 in  
 Max. Resisting Force 11,404 # Passive Pressure = 120 #  
 F.S. : Sliding = 0.77 Friction Pressure = 11,284 #

## SOIL PRESSURE

Eccentricity from CL = 2.04 ft Kern Distance = 2.49 ft

## UN-FACTORED FACTORED

----> SOIL PRESSURE @ TOE = 3,057 psf 5,117 psf  
 ----> SOIL PRESSURE @ HEEL = 304 psf 0 psf

## TOE DESIGN

Mu'' = Upward = 56197.8 ft-# Mu : DESIGN MOMENT = 51123 ft-#  
 Mu' = Downward = 5075 ft-#  
 > % Steel Minimum = 0.0012 Rebar Cover 3.5 in  
 As : Required = 0.566 in^2/ft d = Thk - Cover 20.50 in  
 As : Provided = 0.566 in^2/ft 'm' = 17.65  
 R-u = 135.16 psi  
 One Way Shear : Try: 4.5 " #7 @ 12.5 "  
 Fv = 2\*(f'c ^ .5) = 126.49 psi #5 @ 6.5 " #8 @ 16.5 "  
 Actual Shear / Phi = 100.07 psi #6 @ 9.5 " #9 @ 21.5 "

## HEEL DESIGN

```

-----
> Neglect Upward Soil Pressure? Y=1, N=0          1
-----
Mu'' = Downward Mom. 121232 ft-#    Mu : DESIGN MOMENT = 121232 ft-#
Mu'  = Upward Mom.   = 0 ft-#
Rebar Cover          = 2 in
d = Thk-Cover        = 22.00 in
> % Steel Minimum    = 0.0012      "m"          = 17.65
As : Required = 1.279 in^2/ft      R-u          = 278.31 psi
As : Provided = 1.279 in^2/ft
One Way Shear :
Fv = 2*(f'c ^ .5) = 126.49 psi
Actual Shear / Phi 11.57 psi
Try: 1.50 " #7 @ 5.50 "
     #5 @ 2.50 " #8 @ 7.50 "
     #6 @ 4.50 " #9 @ 9.50 "

```

# TOP STEM SECTION DESIGN

```

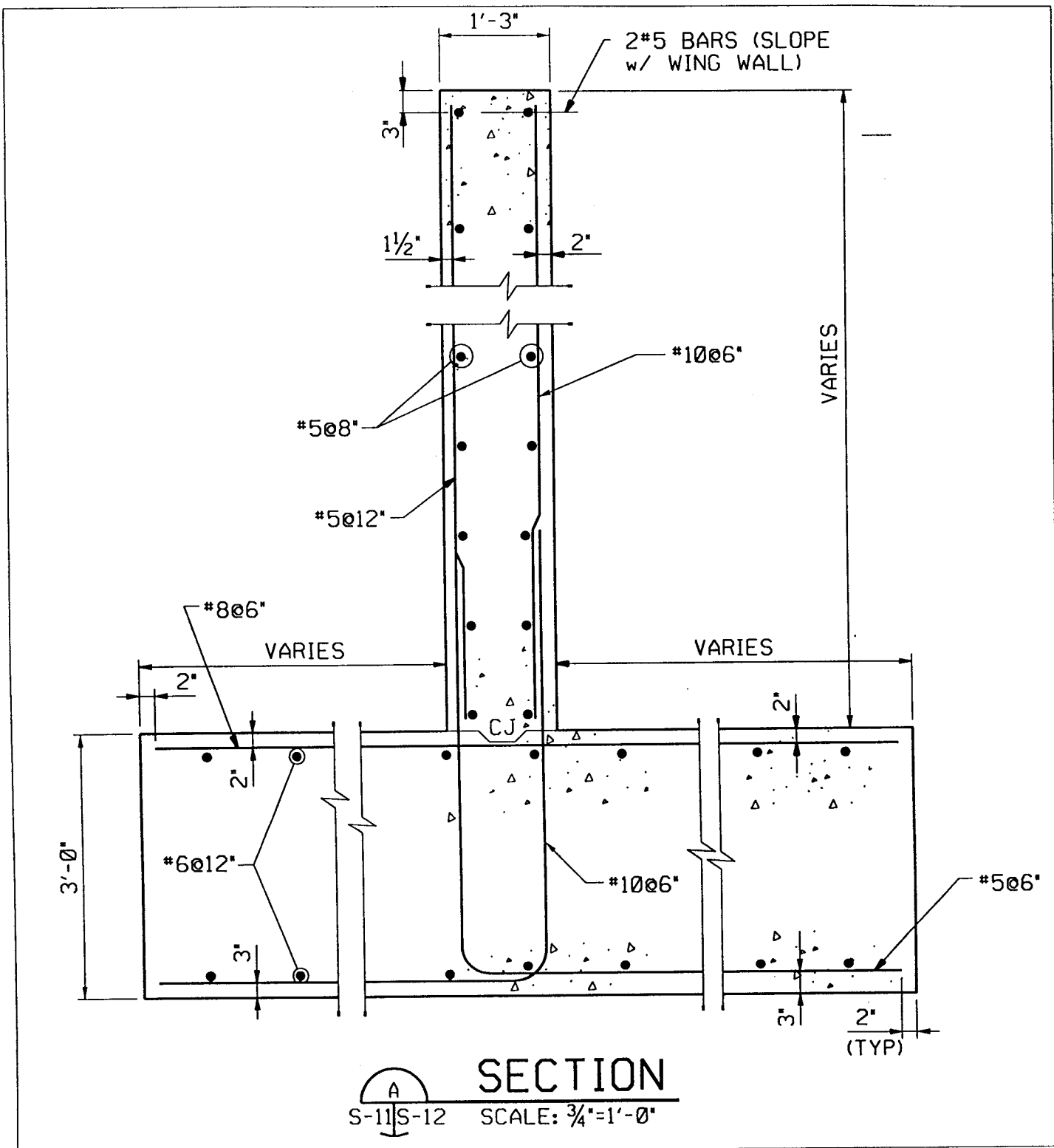
-----
> WALL MATERIAL : CONCRETE = 1, MASONRY. = 2          - 1 <<--
-----
> f'm - Masonry          0 psi > Bottom Ht. above T.O.F.      0 ft
> Fs : for Masonry       0 psi  Loaded Section Height    17.20 ft
> f'c - Concrete        4,000 psi
> Fy : for Concrete     60,000 psi  Total Lateral Press.    = 12044 #
> Load Factor          1.00      Maximum Ms:Service     = 72623 ft-#
> Grouting? Y=1 N=0 > 0
> Inspected ? Y=1, N    0
> Center=1, Edge=2 -- 2
> WALL THICKNESS        = 15 in
> REBAR SIZE            10
> REQ'D SPACING          = 6.25 in
Rebar Area Supplied     = 2.26 in^2
'd' for design          = 13.00 in
Allowable Unit Shear    126.5 psi
Actual Unit Shear       131.2 psi
Masonry : Actual Allow.
f'm = ERR NA psi
fs = ERR NA psi
Bond Length Req'd = NA in

```

17.5 ft Earth Height

EXISTING MOMENT TAKEN ABOUT TOE :

Taking Moments About Toe :	Weight (Lbs)	Moment Arm (ft)	Resisting Moment	Moment About Heel To Calc Soil Pressure		Fact -Load-
				Arm	Moment	
Soil Wt. over Heel	=17,375	10.59	183,911	4.34	75,319	24324.6
Soil Wt. over Toe	= 0	0.00	0	12.42	0	0
Wt of Sloped Soil	= 0	12.03	0	2.89	0	0
Surcharge @ Toe	= 0	2.50	0	12.42	0	0
Surcharge @ Heel	= 0	10.59	0	4.34	0	0
Wt from Adjacent Ftg.	= 0	0.00	0	16.91	0	0
Top Stem Section Wt	= 3,225	5.63	18,141	9.30	29,976	4515
Middle Stem Section Wt	= 0	6.00	0	9.67	0	0
Bottom Stem Section Wt	= 0	5.00	0	8.67	0	0
EFP over Toe	= 0.00	2.00	0	0.00	0.00	0
Axial Load on Stem	= 0	5.63	0	9.30	0	0
Footing Weight	= 4,476	7.46	33,391	7.46	33,391	6266.4
Key Weight	= 0	0.00	0	14.92	0	0
Force on Projecting Stem	= 0.00	0.00	0.00	18.95	0	0
Passive Soil Pressure	= 0	0.00	0	8.67	0	0
<hr/>						
Total Vertical Load #	=25,076	Sum Mom	235,443	25,076	138,687	35106



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