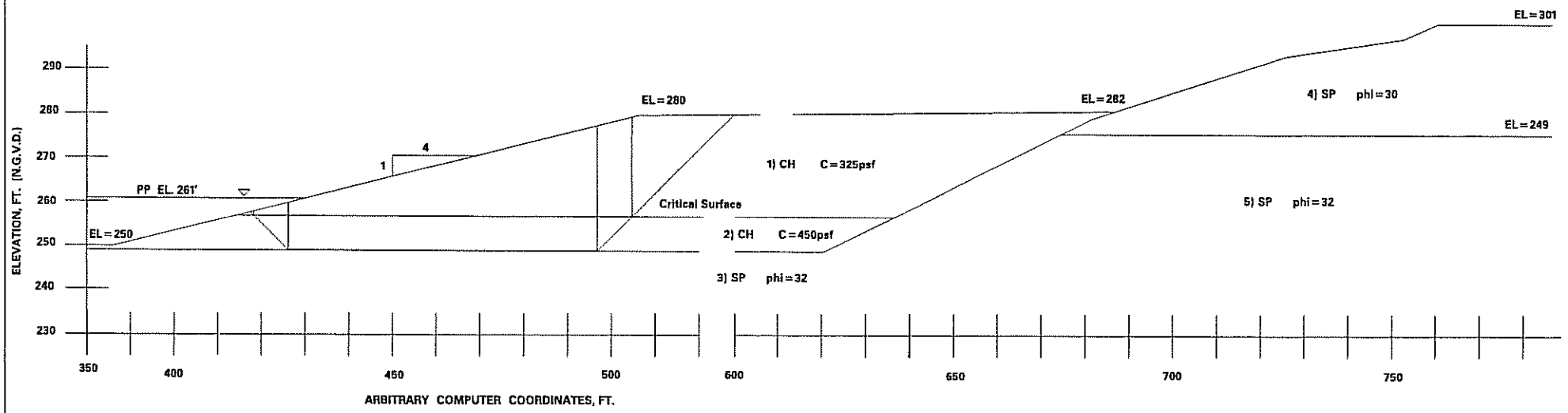


LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN I}}$$

FS = M [30 TAN(20)/30]

FS = M(0.364); for M=4.0: FS=1.46

SOIL SHEAR STRENGTHS – BORING 2-NWTH-00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (-)	C (PSF)	phi (-)	C (PSF)	phi (-)	C (PSF)
1	CH	280.00	110	0	325	10	160	20	0
2	CH	257.00	110	0	450	10	225	20	0
3	SP	249.00	125	32	0	32	0	32	0
4	SP	301.00	125	30	0	30	0	30	0
5	SP	276.00	125	32	0	32	0	32	0

FACTORS OF SAFETY

ARC Failure		Block Failure	
AC	PP	AC	PP
1.428	1.439*	1.328**	1.359*

* Critical Pool EL=261'

** Case Presented

Manual Calculations on Following Page

MISSISSIPPI RIVER AND TRIBUTARIES

NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS

Landside of Harbor

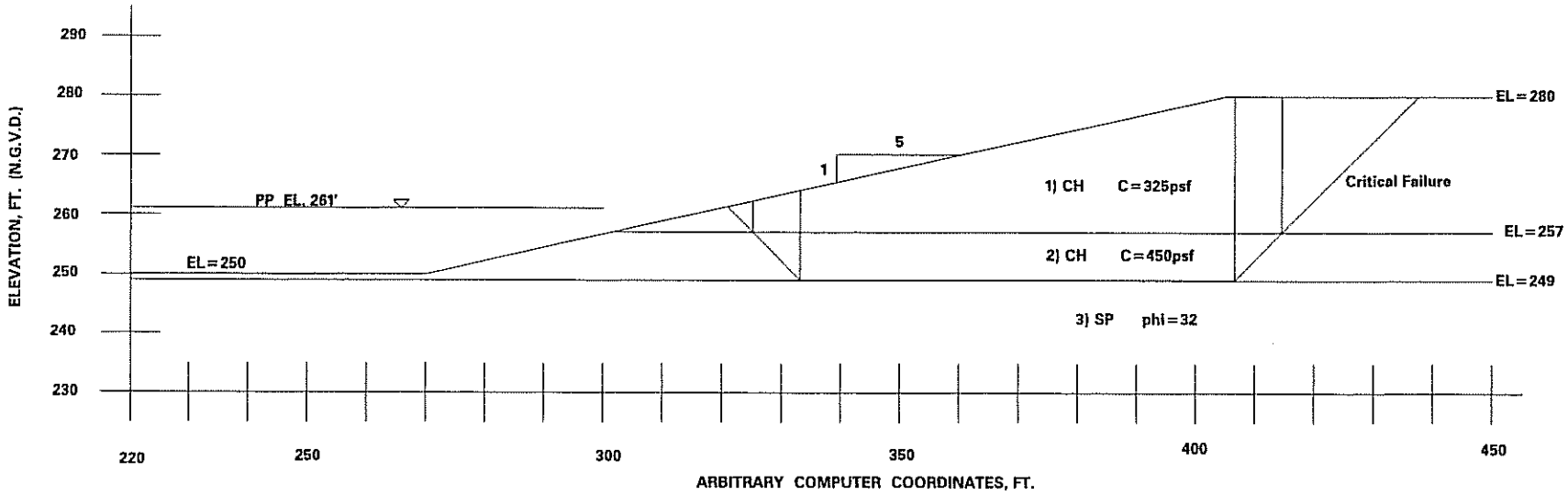
DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

Determine Factor of Safety Manually
Boring 2-NWTH-00
Landside of Harbor

							Active Block		Passive Block		Neutral Block	
Slice No.	Resist wt. lbs	Drive wt. lbs	ϕ deg	c lbs	H (FT)	l (ft)	Drive Force	Resist Force	Drive Force	Resist Force	Drive Force	Resist Force
1	29348.20	29348.20	0.00	325.00	23.25	32.8762	29348.20	15110.55				
2	22299.27	22299.27	0.00	450.00	7.93	11.2147	22299.27	7137.00				
3	152895.30	152895.30	0.00	450.00	0.00	70.44						31698.00
3	152895.30	152895.30	-89.27	450.00	0.00	70.44						
4	5208.73	5208.73	0.00	450.00	7.93	11.2147			5208.73	7137.00		
5	45.33	45.33	0.00	325.00	1.02	1.1483			45.33	659.75		
				Summations:			51647.46	22247.55	5254.06	7796.75		31698.00

FS= 1.330842261

From Geoslope = 1.328 difference= -0.002842261



LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN I}}$$

FS = M [23TAN(20) + 8TAN(20)]/31

FS = M(0.364); for M=5.0: FS=1.82

FACTORS OF SAFETY

ARC Failure		Block Failure	
AC	PP	AC	PP
1.609	1.610*	1.496**	1.499*

* Critical Pool EL=261'
** Case Presented

SOIL SHEAR STRENGTHS – BORING 2-NWTH-00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (-)	C (PSF)	phi (-)	C (PSF)	phi (-)	C (PSF)
1	CH	280.00	110	0	325	10	160	20	0
2	CH	257.00	110	0	450	10	225	20	0
3	SP	249.00	125	32	0	32	0	32	0
4	CH	195.00	110	0	450	10	225	20	0

MISSISSIPPI RIVER AND TRIBUTARIES

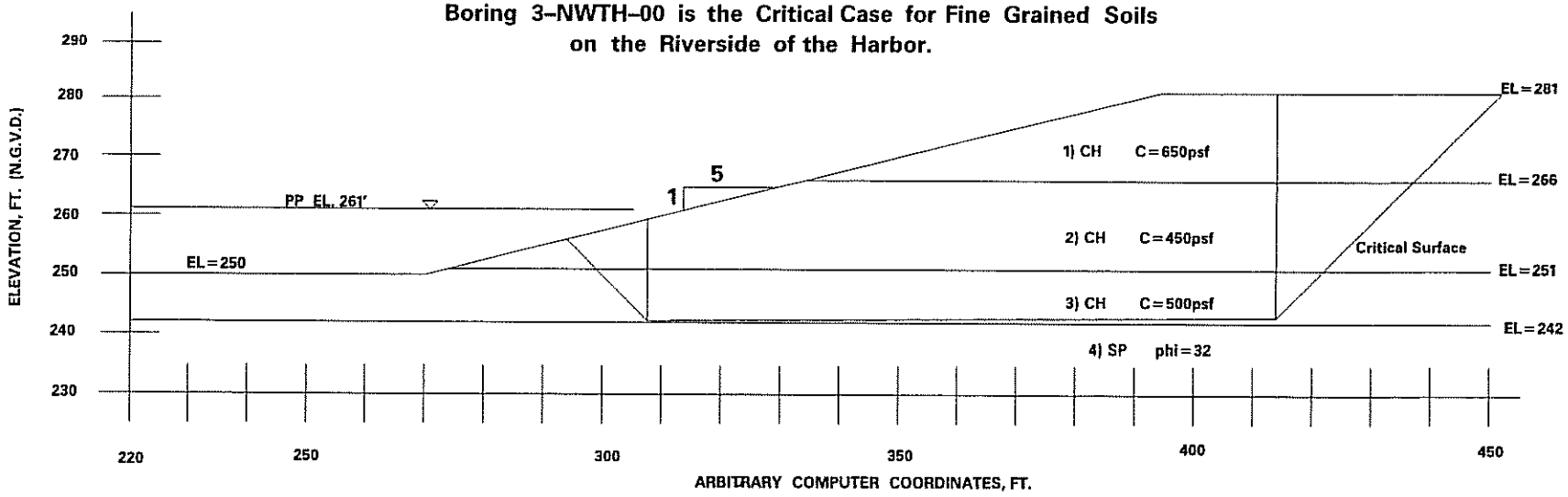
NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS
Riverside of Harbor

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

PLATE 5

Boring 3–NWTH–00 is the Critical Case for Fine Grained Soils on the Riverside of the Harbor.



LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN I}}$$

FS = M [15 TAN(22)+15 TAN(20)+1 TAN(22)/31

FS = M(0.385); for M=5.0: FS=1.92

FACTORS OF SAFETY

ARC Failure		Block Failure	
AC	PP	AC	PP
1.594	1.629*	1.485**	1.578*

* Critical Pool EL=261'
** Case Presented
Manual Calculation Presented on Following Page

SOIL SHEAR STRENGTHS – BORING 3–NWTH–00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (°)	C (PSF)	phi (°)	C (PSF)	phi (°)	C (PSF)
1	CH	281.00	115	0	650	11	325	22	0
2	CH	266.00	110	0	450	10	225	20	0
3	CH	251.00	110	0	500	11	250	22	0
4	SP	242.00	125	32	0	32	0	32	0

MISSISSIPPI RIVER AND TRIBUTARIES

NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS
Riverside of Harbor

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

PLATE 6

Determine Factor of Safety Manually

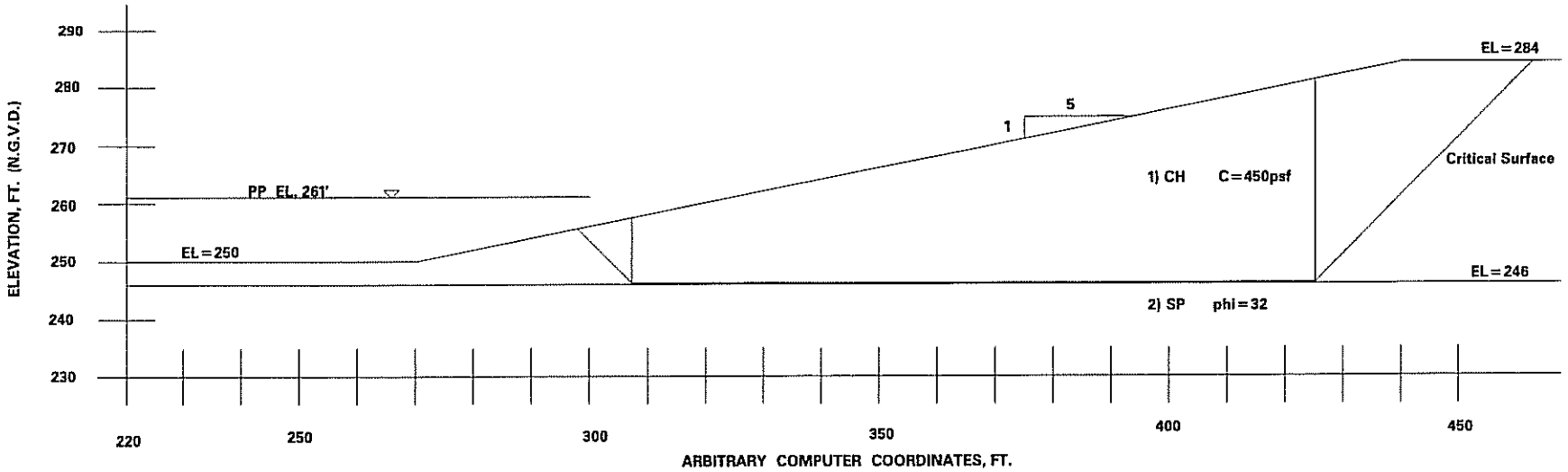
Boring 3-NWTH-00

Riverside of Harbor

							Active Block		Passive Block		Neutral Block	
Slice No.	Resist wt. lbs	Drive wt. lbs	ϕ deg	c lbs	H (FT)	l (ft)	Drive Force	Resist Force	Drive Force	Resist Force	Drive Force	Resist Force
1	12937.50	12937.50	0.00	650.00	15.00	21.2132	12937.50	19500.00				
2	38250.00	38250.00	0.00	450.00	15.00	21.2132	38250.00	13500.00				
3	30538.72	30538.72	0.00	500.00	8.04	1.3199	30538.72	8044.00				
4	352712.19	352712.19	-89.27	500.00	0.68	106.3137	2256.20					
4	352712.19	352712.19	0.00	500.00	0.68	106.3137						53156.85
5	11146.80	11146.80	0.00	500.00	8.72	12.338			11146.80	8724.30		
6	1670.97	1670.97	0.00	450.00	4.93	6.972			1670.97	4437.00		
				Summations:			83982.42	41044.00	12817.76	13161.30		53156.85

FS= 1.508644141

From Geoslope = 1.485 difference= -0.023644141



LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN I}}$$

FS = M [34 TAN(22]/34

FS = M(0.404); for M=5.0: FS=2.02

FACTORS OF SAFETY

ARC Failure		Block Failure	
AC	PP	AC	PP
1.666	1.699	1.510**	1.556

* Critical Pool EL=261'

** Case Presented

SOIL SHEAR STRENGTHS – BORING 4-NWTH-00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (-)	C (PSF)	phi (-)	C (PSF)	phi (-)	C (PSF)
1	CH	284.00	110	0	500	11	250	22	0
2	SP	246.00	120	32	0	32	0	32	0

MISSISSIPPI RIVER AND TRIBUTARIES

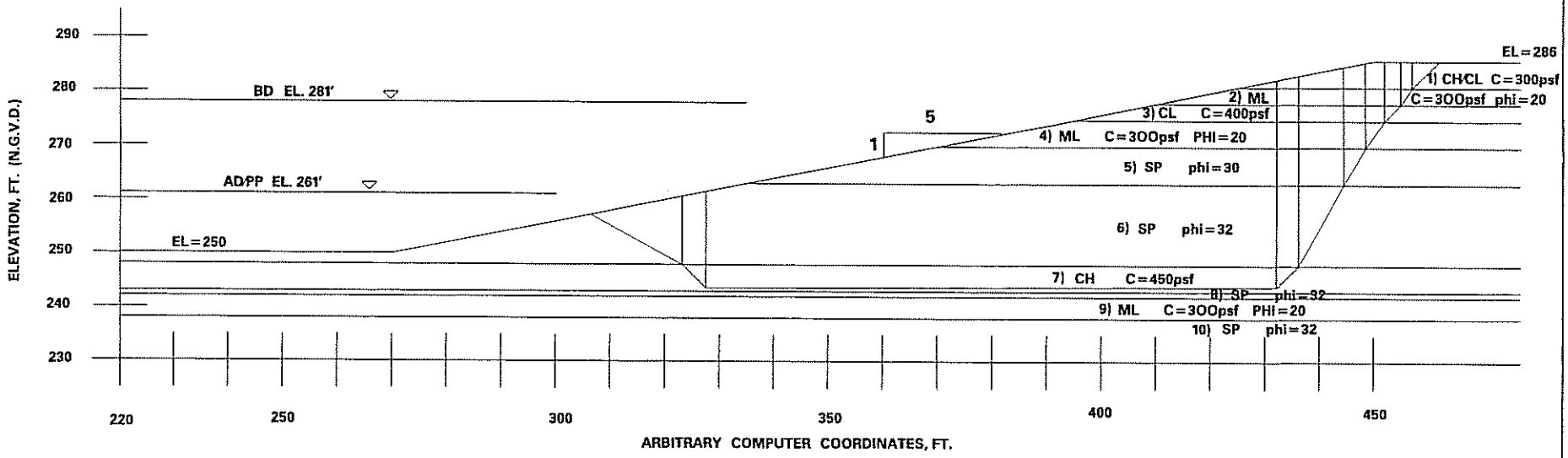
NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS

Riverside of Harbor

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

PLATE 7



LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN i}}$$

FS = M [4.5 TAN(26) + 3.5 TAN(28)+3 TAN(27) +4 TAN(28)+7 TAN(30) +13 TAN(32)]/36

FS = M(0.552); for M=5.0: FS=2.76

FACTORS OF SAFETY

ARC Failure			Block Failure		
AC	SD	PP	AC	SD	PP
2.231	1.490	2.207*	1.544	1.291**	1.617*

* Critical Pool EL= 261'

** Case Presented

SOIL SHEAR STRENGTHS – BORING 5-NWTH-00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (°)	C (PSF)	phi (°)	C (PSF)	phi (°)	C (PSF)
1	CH/CL	286.00	115	0	750	13	150	26	0
2	ML	281.00	120	20	300	20	300	28	0
3	CL	278.00	115	0	500	13	200	27	0
4	ML	275.00	120	20	300	20	300	28	0
5	SP	270.00	125	30	0	30	0	30	0
6	SP	263.00	125	32	0	32	0	32	0
7	CH	248.00	115	0	450	9	150	18	0
8	SP	243.00	125	0	0	32	0	32	0
9	ML	242.00	120	20	300	20	300	28	0
10	SP	238.00	125	32	0	32	0	32	0

MISSISSIPPI RIVER AND TRIBUTARIES

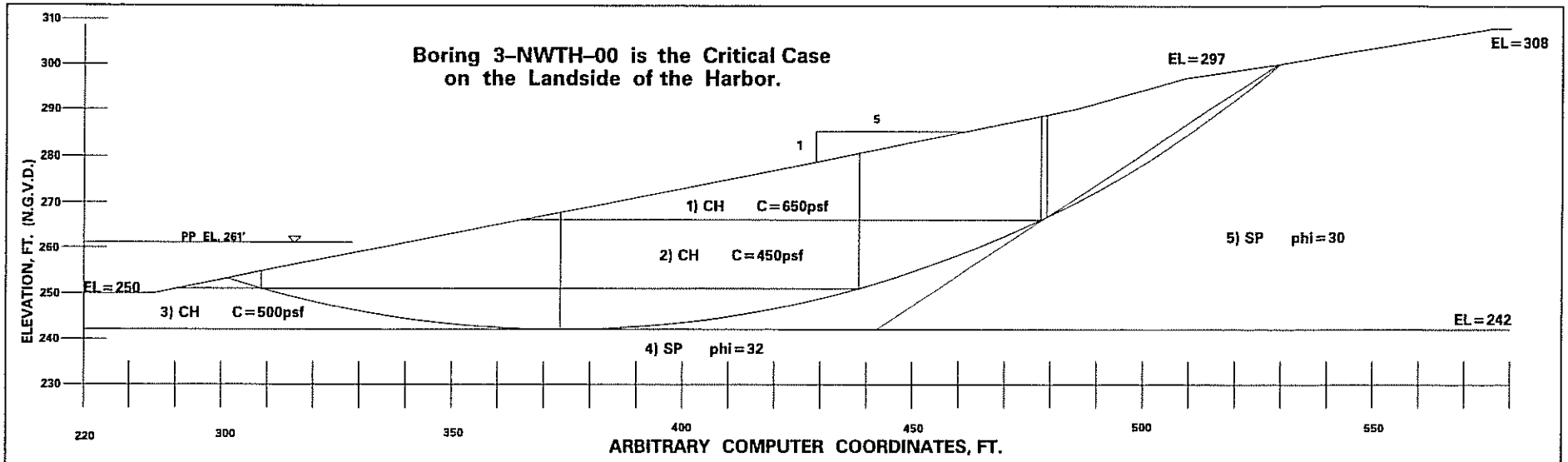
NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS

Riverside of Harbor

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

PLATE 8



LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN I}}$$

FS = M 50 TAN(22)/50

FS = M(0.404); for M=5.0: FS=2.02

FACTORS OF SAFETY

ARC Failure		Block Failure	
AC	PP	AC	PP
1.298**	1.357*	1.300	1.373*

* Critical Pool EL=261'

** Case Presented

Manual Calculations Presented on Following Page

SOIL SHEAR STRENGTHS – BORING 3-NWTH-00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (°)	C (PSF)	phi (°)	C (PSF)	phi (°)	C (PSF)
1	CH	281.00	115	0	650	11	375	22	0
2	CH	261.00	110	0	450	11	225	22	0
3	CH	251.00	110	0	500	11	250	22	0
4	SP	242.00	125	32	0	32	0	32	0
5	SP	308.00	125	30	0	30	0	30	0

MISSISSIPPI RIVER AND TRIBUTARIES

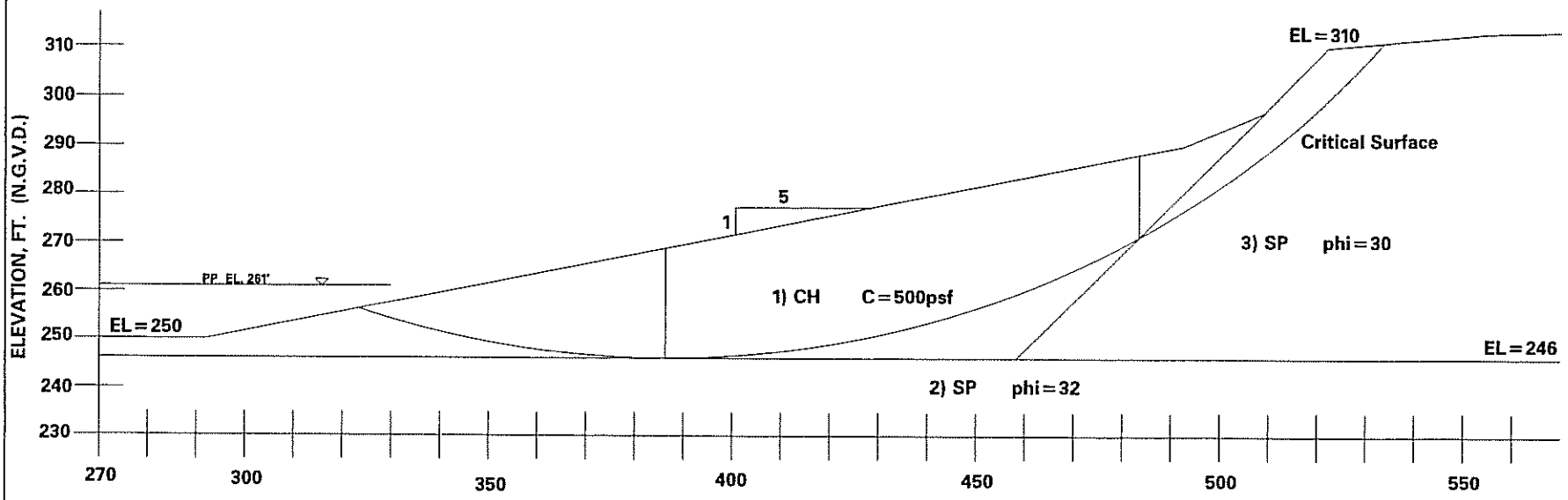
NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS

Landside of Harbor

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

PLATE 9



LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN I}}$$

FS = M [47 TAN(22)]/47

FS = M(0.404); for M=5.0: FS=2.02

FACTORS OF SAFETY

ARC Failure		Block Failure	
AC	PP	AC	PP
1.337**	1.361	1.370	1.402

* Critical Pool EL.= 261'

** Case Presented

SOIL SHEAR STRENGTHS – BORING 4-NWTH-00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (o)	C (PSF)	phi (o)	C (PSF)	phi (o)	C (PSF)
1	CH	284.00	110	0	500	11	250	22	0
2	SP	246.00	125	32	0	32	0	32	0
3	SP	310.00	125	30	0	30	0	30	0

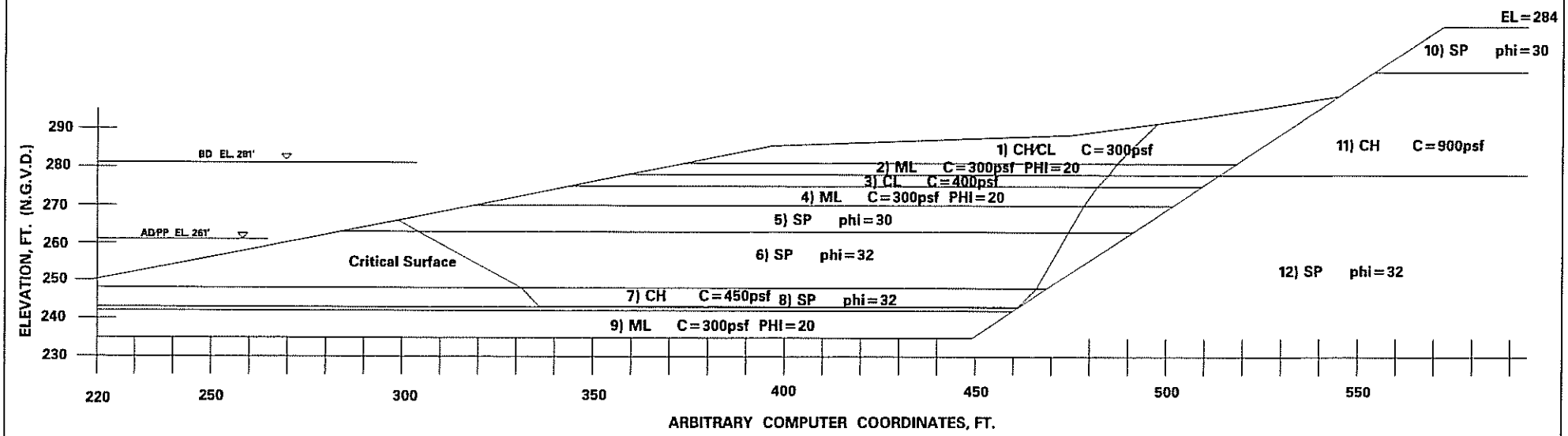
MISSISSIPPI RIVER AND TRIBUTARIES

NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS
Landside of Harbor

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

PLATE 10



LONG TERM STABILITY

$$FS = \frac{\text{TAN phi}}{\text{TAN I}}$$

FS = M [4.5 TAN(26) + 3.5 TAN(28)+3 TAN(27) +4 TAN(28)+7 TAN(30) +13 TAN(32)]/36

FS = M(0.552); for M=5.0: FS=2.76

SOIL SHEAR STRENGTHS - BORING S-NWTH-00

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				phi (-)	C (PSF)	phi (-)	C (PSF)	phi (-)	C (PSF)
1	CH/CL	286.0	115	0	750	13	150	26	0
2	ML	281.0	120	20	300	20	300	28	0
3	CL	278.0	115	0	500	13	200	27	0
4	ML	275.0	120	20	300	20	300	28	0
5	SP	270.0	125	30	0	30	0	30	0
6	SP	263.0	125	32	0	32	0	32	0
7	CH	248.0	115	0	450	9	150	18	0
8	SP	243.0	125	0	0	32	0	32	0
9	ML	242.0	120	20	300	20	300	28	0
10	SP	317.0	125	30	0	30	0	30	0
11	CH	305.0	115	0	900	9	0	18	0
12	SP	278.0 /235.0	125	32	0	32	0	32	0

FACTORS OF SAFETY

A&C Failure			B Block Failure		
A&C	SD	PP	AC	SD	PP
2.203	1.490	2.013*	1.471	1.247**	1.511*

* Critical Pool EL= 261'
** Case Presented

MISSISSIPPI RIVER AND TRIBUTARIES

NORTHWEST TN HARBOR

SLOPE STABILITY ANALYSIS
Landside of Harbor

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
GEOTECHNICAL DESIGN SECTION

PLATE 11

UNIFIED SOIL CLASSIFICATION

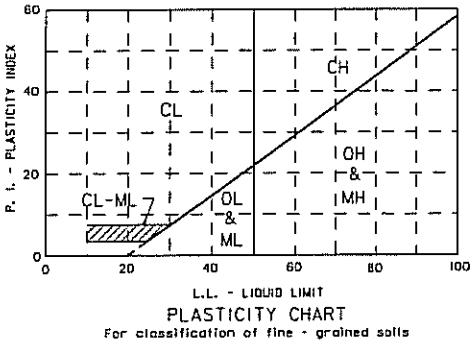
MAJOR DIVISION		TYPE	LETTER SYMBOL	SYMBOL	TYPICAL NAMES
COARSE GRAINED SOILS (More than half the material is larger than No. 200 sieve size)	GRAVEL (More than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVEL (Little or No Fines)	GW		GRAVEL, Well Graded, gravel-sand mixtures, little or no fines
			GP		GRAVEL, Poorly Graded, gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable Amount of Fines)	GM		SILTY GRAVEL, gravel-sand-silt mixtures
			GC		CLAYEY GRAVEL, gravel-sand-clay mixtures
	SAND (More than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SAND (Little or No Fines)	SW		SAND, Well Graded, gravelly sands
			SP		SAND, Poorly Graded, gravelly sands
		SAND WITH FINES (Appreciable Amount of Fines)	SM		SILTY SAND, sand-silt mixtures
			SC		CLAYEY SAND, sand-clay mixtures
FINE GRAINED SOILS (More than half the material is smaller than No. 200 sieve size)		SILTS AND CLAYS (Liquid Limit < 50)	ML		SILT & very fine sand, silty or clayey fine sand or clayey silt with slight plasticity
			CL		LEAN CLAY; Sandy Clay; Silty Clay; of low to medium plasticity
			OL		ORGANIC SILTS, and organic silty clays of low plasticity
		SILTS AND CLAYS (Liquid Limit > 50)	MH		SILT, fine sandy or silty soil with high plasticity
			CH		FAT CLAY, inorganic clay of high plasticity
			OH		ORGANIC CLAYS of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt		PEAT, and other highly organic soil
WOOD			Wd		WOOD
MIXED SAMPLE			VM		Variable mixed silts, clays and sands
NO SAMPLE					

NOTE: Soils possessing characteristics of two groups are designated by combinations of group symbols.

DESCRIPTIVE SYMBOL

COLOR	
COLOR	SYMBOL
TAN	T
YELLOW	Y
RED	R
BLACK	BK
GRAY	Gr
LIGHT GRAY	lGr
DARK GRAY	dGr
BROWN	Br
LIGHT BROWN	lBr
DARK BROWN	dBr
BROWNISH - GRAY	brGr
GRAYISH - BROWN	grBr
GREENISH - GRAY	gnGr
GRAYISH - GREEN	grGn
GREEN	Gn
BLUE	Bl
BLUE - GREEN	BlGn
WHITE	Wh
MOTTLED	Mot

CONSISTENCY FOR COHESIVE SOILS		
CONSISTENCY	COHESION IN LBS./SQ. FT. FROM UNCONFINED COMPRESSION TEST	SYMBOL
VERY SOFT	< 250	vSo
SOFT	250 - 500	So
MEDIUM	500 - 1000	M
STIFF	1000 - 2000	St
VERY STIFF	2000 - 4000	vSt
HARD	> 4000	H



PLASTICITY CHART
For classification of fine - grained soils

MODIFICATIONS	
MODIFICATION	SYMBOL
Traces	Tr -
Fine	F
Medium	M
Coarse	C
Concretions	cn
Rootlets	rt
Lignite fragments	lg
Shale fragments	sh
Sandstone fragments	sds
Shell fragments	slf
Organic matter	O
Clay strata or lenses	CS
Silt strata or lenses	SlS
Sand strata or lenses	SS
Sandy	S
Gravelly	G
Boulders	B
Slickensides	SL
Wood	Wd
Oxidized	Ox
Saturated	sat
Lumps of Clay	Clp

NOTES:

FIGURES TO THE LEFT OF BORING UNDER COLUMN "W OR D_{10}"
Are natural water contents in percent dry weight
When underlined denotes D_{10} size in mm *
FIGURES TO THE LEFT OF BORING UNDER COLUMNS "LL" AND "PL"
Are liquid and plastic limits, respectively
SYMBOLS TO THE LEFT OF BORING
▽ Ground water surface and date observed
(C) Denotes location of consolidation test * *
(S) Denotes location of consolidation - drained direct shear test * *
(R) Denotes location of consolidation - undrained triaxial compression test * *
(Q) Denotes location of unconsolidated - undrained traxial compression test * *
(T) Denotes location of sample subjected to consolidation test and each of the above three types of shear tests * *
FW Denotes free water encountered in boring or sample
o— Denotes channel grade
FIGURES TO THE RIGHT OF BORING
Are values of cohesion in lbs/sq. ft. from unconfined compression tests
In parentheses are driving resistances in blows per foot determined with a standard split spoon sampler (I $\frac{3}{8}$" I.D. 2" O.D.) and a 140 lb. driving hammer with a 30" drop
Where underlined with a solid line denotes laboratory permeability in centimeters per second of undisturbed sample
Where underlined with a dashed line denotes laboratory permeability in centimeters per second of sample remoulded to the estimated natural void ratio

* The D_{10} size of a soil is the grain diameter in millimeters of which 10% of the soil is finer, and 90% coarser than size D_{10}

* * Results of these tests are available for inspection in the U. S. Army Engineer District Office if these symbols appear beside the boring logs on the drawings.

GENERAL NOTES:

While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of subsurface materials of the region are anticipated and if encountered, such variations will not be considered as differing materially within purview of the contract clause entitled, "Differing Site Conditions".

Ground water elevations shown on boring logs represent ground water surfaces encountered in such borings on the dates shown. Absence of water surface data on certain borings indicates that no ground water data are available from the borings but does not necessarily mean that ground water will not be encountered at the locations or within the vertical reaches of such borings.

Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

STANDARD BORING LEGEND

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS

PLATE 12