APPENDICES

The following pages contain the miscellaneous material referenced in the main body of the Technical Reference. Appendix A consists of various tables of coefficients.

APPENDIX A - TABLES

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APPENDIX A - TABLES

Table A-1

K_D Values for Use in Determining Armor Unit Weight (Source: EM 1110-2-2904)							
			Structure Trunk[7]		Structure Head		
Armor Units	n[2]	Placement	Breaking Wave	Nonbreaking Wave	Breaking Wave	Nonbreaking Wave	Slope cot θ
Quarrystone							
Smooth rounded	2	Random	1.2[1]	2.4	1.1[1]	1.9	1.5-3.0[8]
Smooth rounded	>3	Random	1.6[1]	3.2[1]	1.4[1]	2.3[1]	1.5-3.0[8]
Rough angular	1	Random[3]	---[3]	2.9[1]	---[3]	2.3[1]	1.5-3.0[8]
Rough angular	2	Random	2.0	4.0	1.9[1] 1.6[1] 1.3	3.2 2.8 2.3	1.5 2.0 3.0
Rough angular	>3	Random	2.2[1]	4.5[1]	2.1[1]	4.2[1]	1.5-3.0[8]
Rough angular	2	Special[4]	5.8	7.0	5.3[1]	6.4	1.5-3.0[8]
Parallelepiped[9]	2	Special	7.0 - 20.0	8.5 - 24.0[1]	---	---	1.0-3.0
Tetrapod and Quadripod	2	Random	7.0	8.0	5.0[1] 4.5[1] 3.5[1]	6.0 5.5 4.0	1.5 2.0 3.0
Tribar	2	Random	9.0[1]	10.0	8.3[1] 7.8[1] 6.0	9.0 8.5 6.5	1.5 2.0 3.0
Dolos	2	Random	15.0[6]	31.0[6]	8.0[1] 7.0	16.0[1] 14.0[1]	2.0[5] 3.0
Modified cube	2	Random	6.5[1]	7.5	---	5.0[1]	1.5-3.0[8]
Hexapod	2	Random	8.0[1]	9.5	5.0[1]	7.0[1]	1.5-3.0[8]
Toskane	2	Random	11.0[1]	22.0	---	---	1.5-3.0[8]
Tribar	1	Uniform	12.0	15.0	7.5[1]	9.5[1]	1.5-3.0[8]
Quarrystone - graded angular riprap	-	Random	2.2	2.5	---	---	---

(1) CAUTION: These K_D values are unsupported and are provided only for preliminary design.

(2) n is the number of units comprising the thickness of the armor layer.

(3) The use of single layer of quarrystone armor units is not recommended for structures subject to breaking waves, and only under special conditions for structures subject to nonbreaking waves. When it is used, the stone should be carefully placed.

(4) Special placement with long axis of stone placed perpendicular to structure face.

(5) Stability of dolosse on slopes steeper than 1 on 2 should be substantiated by site-specific tests.

(6) Refers to no-damage criteria (<5 percent displacement, rocking, etc.); if no rocking (<2 percent) is desired, reduce K_D 50 percent (Zwamborn and Van Niekerk, 1982).

(7) Applicable to slopes ranging from 1 on 1.5 to 1 on 5.

(8) Until more information is available, the use of K_D should be limited to slopes ranging from 1 on 1.5 to 1 on 3. Some armor units tested on a structure head indicate a K_D-slope dependence.

(9) Parallelepiped-shaped stone: long slab-like stone with long dimension approximately three times the shortest dimension (Markle and Davidson, 1979).

Table A-2

Layer Coefficient and Porosity for Various Armor Units (Source: SPM)				
Armor Unit	n	Placement	Layer Coefficient	Porosity %
Quarrystone (smooth)	2	Random	1.02	38
Quarrystone (rough)	2	Random	1.00	37
Quarrystone (rough)	>3	Random	1.00	40
Quarrystone (parallelepiped)	2	Special	-	27
Cube (modified)	2	Random	1.10	47
Tetrapod	2	Random	1.04	50
Quadripod	2	Random	0.95	49
Hexipod	2	Random	1.15	47
Tribar	2	Random	1.02	54
Dolos	2	Random	0.94	56
Toskane	2	Random	1.03	52
Tribar	1	Uniform	1.13	47
Quarrystone	Graded	Random	-	37

Table A-3

Rough Slope Run-Up Coefficients (Source: Smith, 1986)		
Armor Material	a	b
Riprap	0.956	0.398
Rubble (Permeable - No Core)	0.692	0.504
Rubble (2 Layers - Impermeable Core)	0.775	0.361
Modified Cubes	0.950	0.690
Tetrapods	1.010	0.910
Quadripods	0.590	0.350
Hexapods	0.820	0.630
Tribars	1.810	1.570
Dolosse	0.988	0.703

Table A-4

Grain-Size Scales (Soil Classification)						
	Unified Soils Classification	ASTM Mesh	PHI	MM	Wentworth Classification	
			-8.00	256.00		
	Cobble		-7.00	128.00		
			-6.75	107.60	Cobble	
			-6.50	90.51		
			-6.25	76.11		
			-6.00	64.00		
			-5.75	53.82		
	Coarse Gravel		-5.50	45.26		G
			-5.25	38.06		
			-5.00	32.00		R
			-4.75	26.91		
			-4.50	22.63		A
			-4.25	19.00		
			-4.00	16.00	Pebble	V
			-3.75	13.45		
	Fine Gravel		-3.50	11.31		E
			-3.25	9.51		
		2.5	-3.00	8.00		L
		3	-2.75	6.73		
		3.5	-2.50	5.66		
		4	-2.25	4.76		
		5	-2.00	4.00		
	Coarse	6	-1.75	3.36		
		7	-1.50	2.83	Granule	
		8	-1.25	2.38		
		10	-1.00	2.00		
		12	-0.75	1.68		
		14	-0.50	1.41	Very Course	
		16	-0.25	1.19		
S	Medium	18	0.00	1.00		
		20	0.25	0.84		
A		25	0.50	0.71	Coarse	
		30	0.75	0.59		S
N		35	1.00	0.50		
		40	1.25	0.42		A
D		45	1.50	0.35	Medium	
		50	1.75	0.30		N
		60	2.00	0.25		
		70	2.25	0.21		D
	Fine	80	2.50	0.177	Fine	
		100	2.75	0.149		
		120	3.00	0.125		
		140	3.25	0.105		
		170	3.50	0.088	Very Fine	
		200	3.75	0.074		
		230	4.00	0.0625		
		270	4.25	0.0526		
		325	4.50	0.0442		
	Silt	400	4.75	0.0372	Silt	M
			5.00	0.0313		
			6.00	0.0156		U
			7.00	0.0078		
			8.00	0.0039		D
			9.00	0.0020		
	Clay		10.00	0.0009	Clay	
			12.00	0.0002		

Table A-5

Major Tidal Constituents		
Symbol	Constituent Name	Frequency (degrees/hour)
M_2	Lunar semidiurnal	28.984
S_2	Principal solar semidiurnal	30.000
N_2	Larger lunar elliptic semidiurnal	28.439
K_1	Lunisolar diurnal	15.041
M_4	Shallow-water overtide of principal lunar	57.968
O_1	Principal lunar diurnal	13.943
M_6	Shallow-water overtide of principal lunar	86.952
MK_3	Shallow-water compound	44.025
S_4	Shallow-water overtide of principal solar	60.000
MN_4	Shallow-water compound	57.423
$\nu 2$	Larger lunar evectional	28.512
S_6	Shallow-water overtide of principal solar	90.000
$\mu 2$	Variational	27.968
$2N_2$	Lunar elliptic semidiurnal (second order)	27.895
00_1	Lunar diurnal (second order)	16.139
$\lambda 2$	Smaller lunar evectional	29.455
S_1	Solar diurnal	15.000
M_1	Smaller lunar elliptic diurnal	14.496
J_1	Smaller lunar elliptic diurnal	15.585
M_m	Lunar monthly	0.544
S_{sa}	Solar semidiurnal	0.082
S_a	Solar annual	0.041
M_{sf}	Lunisolar synodic fortnightly	1.015
M_f	Lunar fortnightly	1.098
$\rho 1$	Larger lunar evectional diurnal	13.471
Q_1	Larger lunar elliptic diurnal	13.398
T_2	Larger solar elliptic	29.958
R_2	Smaller solar elliptic	30.041
$2Q_1$	Lunar elliptic diurnal (second order)	12.854
P_1	Solar diurnal	14.958
$2SM_2$	Shallow-water compound	31.015
M_3	Lunar terdiurnal	43.476
L_2	Smaller lunar elliptic semidiurnal	29.528
$2MK_3$	Shallow-water compound	42.927
K_2	Lunisolar semidiurnal	30.082
M_8	Shallow-water overtide of principal lunar	115.936
MS_4	Shallow-water compound	58.984

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13. ABSTRACT *(Maximum 200 words)*

The Automated Coastal Engineering System (ACES) is an interactive computer-based design and analysis system in the field of coastal engineering. The general goal of the ACES is to provide state-of-the-art computer-based tools that will increase the accuracy, reliability, and cost-effectiveness of Corps coastal engineering endeavors. Reflecting the nature of coastal engineering, methodologies (called "applications" in this guide) contained in this release of the ACES are richly diverse in sophistication and origin. The contents range from simple algebraic expressions, both theoretical and empirical in origin, to numerically intense algorithms spawned by the increasing power and affordability of computers. Historically, the methods range from classical theory describing wave motion, to expressions resulting from tests of structures in wave flumes, and to recent numerical models describing the exchange of energy from the atmosphere to the sea surface.

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In a general procedural sense, much has been taken from previous individual programs on both mainframes and microcomputers. The ACES is designed for a current base of PC-AT (including compatibles) class of personal computers resident at many Corps coastal offices. While expected to migrate to more powerful hardware technologies, this current generation of ACES is designed for the above environemnt and is written in FORTRAN 77.

The documentation set for the ACES comprises two manuals: User's Guide and Technical Reference. The User's Guide contains instructions for using the individual applications within the ACES software package. The Technical Reference contains theory and discussion of the various methodologies contained in the ACES.