

AUTOMATED COASTAL ENGINEERING SYSTEM

TECHNICAL REFERENCE

by

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Copies of this software may be obtained from the Federal Software Exchange Center, National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 or 703-487-4650.

PREFACE

The Automated Coastal Engineering System (ACES) is being developed by the Automated Coastal Engineering (ACE) Group, Research Division (RD), Coastal Engineering Research Center (CERC), US Army Engineer Waterways Experiment Station (WES). Funding for the effort is part of the Coastal Structures Evaluation and Design Research and Development Program. Messrs. John H. Lockhart, Jr., John G. Housley, Barry W. Holiday, and David Roellig are the Technical Monitors, Headquarters, US Army Corps of Engineers, for this program.

Development of the system was performed by Mr. David A. Leenknecht, Principal Investigator of the ACES, assisted by Mrs. Ann R. Sherlock, ACE Group. Contributors in the development were Miss Willie A. Brandon, Dr. Robert E. Jensen, Mr. Doyle L. Jones, Dr. Edward F. Thompson, CERC, Mr. Michael E. George, Information Technology Laboratory (ITL), and Mr. David W. Hyde, Structures Laboratory, WES; former CERC employees who also made contributions include Mr. John Ahrens, National Oceanic and Atmospheric Administration Sea Grant, Silver Spring, MD; Dr. Mark R. Byrnes, Louisiana State University, Baton Rouge, LA; Mr. Peter L. Crawford, US Army Engineer (USAE) District, Buffalo (NCB); Miss Leslie M. Fields, Aubrey Consultants Incorporated, Falmouth, MA; Mr. James M. Kaihatu, University of Delaware, Newark, DE; and Mr. Kent A. Turner, USAE Division, Lower Mississippi Valley. This report was edited by Mrs. Janean Shirley, ITL, WES.

The work was performed under the general supervision of Dr. James R. Houston, Director, CERC; Mr. Charles C. Calhoun, Jr., Assistant Director, CERC; Ms. Carolyn M. Holmes, CERC Coastal Program Manager; Mr. H. Lee Butler, Chief, RD; and under the direct supervision of Mr. Andre Szuwalski, Chief, ACE Group. Commander and Deputy Director of WES during publication of this guide was COL Leonard G. Hassell, EN. Dr. Robert W. Whalin was the Director of WES.

A Corps-wide Pilot Committee of coastal specialists guides the direction of the ACES effort. Members of the ACES Pilot Committee during this period were Mr. George Domurat, (Chairman), USAE Division, South Pacific (SPD); Mr. Dave Timpy, (Vice-Chairman), USAE District, Wilmington; Mr. John Oliver, USAE Division, North Pacific; Mr. Doug Pirie, SPD; Mr. Peter Crawford, NCB; Mr. Doug Gaffney, USAE District, Philadelphia; Ms. Cheryl Ulrich, USAE District, Mobile; Mr. Housley; and Dr. C. Linwood Vincent (CERC).

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INTRODUCTION

GENERAL GOALS OF THE ACES

The Automated Coastal Engineering System (ACES) is an interactive computer-based design and analysis system in the field of coastal engineering. In response to a charge by the Chief of Engineers, LTG E. R. Heiberg III, to the Coastal Engineering Research Board (US Army Engineer Waterways Experiment Station, 1985) to provide improved design capabilities to Corps coastal specialists, the Coastal Engineering Research Center (CERC) conducted a series of six regional workshops in July 1986 to gather input from Corps field offices concerning various aspects of an ACES. Subsequent to the workshops, the ACES Pilot Committee and various working committees were formed from coastal experts throughout the Corps, and the Automated Coastal Engineering (ACE) Group was formed at CERC. 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.

ACES CONTENTS

Reflecting the nature of coastal engineering, methodologies 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. In a general procedural sense, much has been taken from previous individual programs on both mainframes and microcomputers.

The various methodologies included in ACES are called **applications** and are organized into categories called **functional areas** differentiated according to general relevant physical processes and design or analysis activities. A list of the applications currently resident in the ACES is given in the table on the next page.

TARGET HARDWARE ENVIRONMENT

A strong preference expressed in the workshops and subsequent meetings was for the system to reside in a desktop hardware environment. To meet this preference, the ACES is designed to reside on the current base of PC-AT 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 environment and is written in FORTRAN 77.

DOCUMENT OVERVIEW

The documentation set for the ACES comprises two manuals: *Technical Reference* and *User's Guide*.

- * The *Technical Reference* contains theory and discussion of the various methodologies contained in the ACES. The material included in the *Technical Reference* is relatively brief. For essential features of derivations and mathematical manipulations of equations presented in each section of this manual, the reader is strongly directed to references presented at the end of each application description.
- * The *User's Guide* contains instructions for using individual applications within the ACES software package.

Current ACES Applications	
Functional Area	Application Name
Wave Prediction	Windspeed Adjustment and Wave Growth
	Beta-Rayleigh Distribution
	Extremal Significant Wave Height Analysis
	Constituent Tide Record
Wave Theory	Linear Wave Theory
	Cnoidal Wave Theory
	Fourier Series Wave Theory
Wave Transformation	Linear Wave Theory with Snell's Law
	Irregular Wave Transformation (Goda's method)
	Combined Diffraction and Reflection by a Vertical Wedge
Structural Design	Breakwater Design Using Hudson and Related Equations
	Toe Protection Design
	Nonbreaking Wave Forces on Vertical Walls
	Rubble-Mound Revetment Design
Wave Runup, Transmission, and Overtopping	Irregular Wave Runup on Beaches
	Wave Runup and Overtopping on Impermeable Structures
	Wave Transmission on Impermeable Structures
	Wave Transmission Through Permeable Structures
Littoral Processes	Longshore Sediment Transport
	Numerical Simulation of Time-Dependent Beach and Dune Erosion
	Calculation of Composite Grain-Size Distribution
	Beach Nourishment Overfill Ratio and Volume
Inlet Processes	A Spatially Integrated Numerical Model for Inlet Hydraulics

REFERENCE

US Army Engineer Waterways Experiment Station. 1985. *Proceedings of the 44th Meeting of the Coastal Engineering Research Board*, 4-6 November 1985, Sausalito, California, James R. Houston, Editor, Vicksburg, MS, pp. 11-21.