AUTOMATED COASTAL ENGINEERING SYSTEM

USER'S GUIDE

by

David A. Leenknecht, Andre Szuwalski

and Ann R. Sherlock

Coastal Engineering Research Center

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199

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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.

General Instructions and Information

User Interface

This version of the Automated Coastal Engineering System (ACES) employs a menu-driven environment. Menus are displayed on the screen, and in general, single keystrokes (usually the F1-F10 function keys) are required to select activities or options in the system. Cursor keys are used to select between highlighted input fields (displayed in reverse video). Some applications allow input through data saved in an external file. Results from computations are normally displayed in tabular format on the screen and/or written to print files or devices and/or displayed as plots. Appendix D is a summary table listing the input and output options for the applications available in this version of ACES.

Starting

Appendix B provides installation instructions for the ACES software including graphics options. (Appendix C specifically discusses the graphics options.) The installation procedure described in Appendix B suggests copying the ACES files into a subdirectory called **ACES107**. To begin a session:

1. Type **CD\ACES107** and press ENTER.
2. Type **ACES** and press ENTER.

The Main Menu of ACES is displayed, and single keystrokes become the primary selection mechanism for the session.

Ending

From any point in the system, repeated use of the F10 key returns to successively higher menu levels and, ultimately, back to DOS. Exceptions occur when lengthy computations are in progress (they must be allowed to finish) and when incorrect data have been specified in interactive input fields (valid data must be respecified).

Definitions

An individual methodology included in the system is called an *application* and is assigned to a *functional area* according to its general end product. An operational *mode* (Single or Multiple Case) describes the type of general activity or type of input associated with a given session. This information is displayed on the screen while applications are executed in the system.

MODES

The Main Menu of ACES provides access to two (with some exceptions) separate operational modes:

Option	Main Activity (Mode)
F1	Single Case Mode
F2	Multiple Case Mode

It also provides an F10 option to exit the system. Each of the modes is discussed below.

Single Case Mode Execution

This is one of the two execution modes requiring active participation with an application. From the Functional Area Menu, a specific application is selected from successive menus. Data for a single case are specified by moving the cursor to highlighted data input fields and specifying the value; results are displayed on the screen and can optionally be sent to a print file or device. Errors are identified, and recovery by respecification of the data is allowed. Successive execution with new values (all or individual data items ... called a new case) is an option.

Multiple Case Mode Execution

Like Single Case Mode, this execution mode is interactively selected from successive menus and also requires active participation with an application, but allows specification of sets of data values for most input variables. Sets of data are specified by declaring a range of values (minimum, maximum, and increment) or up to 20 discrete values for each variable in highlighted fields on the display screen. After entry of all sets of data (for all input variables), the permutations of the data sets are processed as discrete cases. Intended primarily for performing sensitivity or economic analysis, the Multiple Case Mode provides a powerful mechanism for looking at the effects of ranges of data. Execution results are written to the print file or device only.

> **CAUTION:** Care should be taken to process a reasonable number of cases. (For convenience, the total number of cases to be processed is displayed.) *There are no limits imposed by the system to the number of cases possibly generated by using an incremental specification.*

> **NOTE:** The most effective way to use the Multiple Case Mode is to pick one parameter and assign it multiple values, and assign only *one* value to the remaining parameters.

Exceptions
Not all applications will have access to both operational modes. There are a number of applications that allow only a Single Case Mode. In these applications, the Single Case Mode will normally have two options of interaction. The first option allows entering initial or new data as described above. The second option allows direct editing of a previously created data file for the particular application (see section entitled **Trace Output File**).

General Data Specifications

For a given session, the information listed below is considered constant for all activities and is specified only once after selection of an operational mode from the Main Menu.

System of Units
This item refers to the general system of units in which results are displayed and printed (US Customary or Metric). Input variables are permitted many units, but final summaries are reported in the selected system of units. Specific units for each variable are itemized in the documentation for each application. The default is **US CUST**omary.

NOTE: The terms US Customary and English units are used interchangeably in this document.

General Water Type
Choose between sea or fresh water. Average fluid properties are assumed based upon this specification. The default is **SEA** water.

Title
A 65-character title block is provided for unique identification of results from a given session. This title block is printed as part of the page banner (under the Project heading) on printed output.

Print File/Device
Specify the name of the target DOS device or file name (including directory path) for all output selected for printing. The default is **LPT1**.

NOTE: All file (including directory path) and device names are restricted to 20 characters.

Page Ejects

When running in Single Case Mode, the printer can be forced to print the output results of each application processed on a separate page. This could use much paper if many cases are processed. The default is **NO** page ejects.

Files

A number of input and output files are handled by the system. File overwrite protection is provided by the ACES package with optional overrides offered to the user for existing files; actual file names should be specified for maximum protection and efficiency. Specific input and output files are discussed below.

Trace Output File

Certain applications allow input via an existing file. These same applications also record the history of input during a session by writing the input data to a file. Any valid DOS file name (including directory path) may be specified for this file. The default file is named **TRACE.OUT**. If the file **TRACE.OUT** already exists, a warning message is displayed at the bottom of the screen. The following file-handling options are then displayed and available:

F1	Replace it. Existing data in the **TRACE.OUT** file will be deleted and a new **TRACE.OUT** file created.
F2	Choose another file. This option allows the user to rename the **TRACE.OUT** file, thus saving the data created in an earlier session. Any valid DOS file name (including directory path) may be specified.
F3	Append output to it. This option will append any input during the present session to the existing **TRACE.OUT** file.
F10	Return to previous menu.

Plot Output Files

These files will contain output data generated by certain applications. The files can then be used outside the ACES environment. The specific content and format of these files are described in the section of this manual that describes the application which generates them. Default names are

PLOTDAT1.OUT, **PLOTDAT2.OUT**, **PLOTDAT3.OUT**. If any of these files already exist when an ACES session is begun, a warning message is displayed at the bottom of the screen, and the same file-handling options that were available for the **TRACE.OUT** file are then displayed.

DEFAULTS

Default values appear in the data fields of many applications in Single Case Mode. These values are for demonstration purposes only. Actual data should always be specified for variables in the applications. After the first execution of an application within a session, data are retained from case to case until changed.

ERRORS

Errors are reported on the display screen, but corrected differently for the two execution modes. In general, errors may be corrected in Single and Multiple Case Modes.