1 INTRODUCTION

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1.1 What is ASEAM3.0?

A Simplified Energy Analysis Method, Version 3.0 (ASEAM3.0), is a modified bin method program for calculating the energy consumption of residential and simple commercial buildings. The additional new features of ASEAM3.0 - as compared to ASEAM2.1 - are described in the next section. ASEAM3.0 runs on an IBM PC and compatibles with at least 256 kilobytes of memory and a hard disk. Like ASEAM2.1, ASEAM3.0 features include:

■ Input Features

Full screen editing: Entering data into ASEAM3.0 is easy and straightforward. Input questions are accessed through cursor control keys on the keyboard.

User-friendly features: ASEAM3.0 has many user-friendly features, including error checking, help messages, and default values. Data entry and editing features are included.

Quick input routine: Given a limited amount of input data, such as building shape and dimensions, percent glass, space types, and system types, ASEAM3.0 can calculate areas and use default values based on the information you provide, and can write complete input files for the calculations.

■ Calculation Features

Use of standard algorithms: Wherever possible, ASEAM3.0 uses recognized algorithms from such sources as the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), Illuminating Engineering Society (IES), the DOE-2 program, and the National Bureau of Standards (NBS).

Calculation can be displayed: You can display and print the calculations simply by pressing the function keys while the calculations are being performed. Many of the calculations are displayed graphically.

Calculation Speed and Capacity: ASEAM3.0 can perform calculations for a typical five-zone building in seven minutes. Up to 15 thermal load zones can be specified in ASEAM3.0. Thirteen different system types, five heating plants, and seven cooling plants can be simulated.

Peak Load and Equipment Sizing: ASEAM3.0 calculates both zone and building peak loads and can automatically size equipment based on these loads. You can also specify equipment sizes.

Calculation Modes: Calculations can be performed in several modes:

Single or Batch Mode: As many as 20 combinations of input files can be selected for analysis. A wide range of outputs can be selected for each analysis.

Parametric Processor Mode: The parametric processor is a powerful tool for analyzing many alternate building and system configurations. When using

the parametric processor, you begin by defining the base-case input files to be modified and then selecting both the input variables to be changed and the output variables for the report. ASEAM3.0 then performs the calculations, automatically changing input values in a looping pattern. Variables can be studied individually or in combination with other variables. The selected calculation output variables are stored in a LOTUS-compatible file. A new "coordinated" parametric input program (AS3CPIP) has been added in ASEAM3.0. This is described in Section 11.5

ECO Mode: Energy Conservation Opportunities (ECOs) are studied with ASEAM3.0 by comparing original (base case) energy consumption and cost with alternative (ECO) energy consumption and cost. ECOs can be studied individually or in combination with other ECOs.

Note: After all the runs have been specified and the calculations begun, ASEAM3.0 can run unattended. Using the parametric processor, you can stack up as many as several hundred runs and leave the computer running overnight. Output files will be saved in the data subdirectory.

Life-Cycle Costing: The Life-Cycle Cost program BLCC, developed by the National Institute of Standards and Technology (formerly the National Bureau of Standards), is integrated into ASEAM3.0. Older FBLCC and NBSLCC life-cycle cost programs are no longer supported by ASEAM3.0.

■ Output Features

Thirty-nine different calculation output reports, many of which are LOTUS-compatible, can be specified in ASEAM3.0. While the calculations are being performed, you can either display or print the calculation parameters. Input data echo reports also are provided. A new "stand-alone" reports program has been added in ASEAM3.0. This is described in Section 12.5.8.

■ Public Domain

The source code of ASEAM3.0 is provided. The algorithms used can be studied in detail and changed if desired. The BASIC code is structured and documented. Wherever possible, equations in the BASIC source code are referenced to outside sources such as the DOE-2 Program Manual.

■ Weather

ASEAM3.0 can use bin weather data in three formats. Data from 46 major U.S. cities' weather stations are included. You can add to or change ASEAM3.0's weather files.

1.2 New Features in ASEAM3.0

Several new features or improvements have been added to the ASEAM2.1 program. These features include:

hard disks - the use of hard disk subdirectories for data and weather storage is required in ASEAM3.0. (instead of defaulting to the floppy drive 'B')

Important - In ASEAM3.0, the names of the subdirectories for input data and weather file storage can be changed only from the ASEAM3.0 Main Menu. See section 3.2.1 for additional information on changing the subdirectory names.

math coprocessors - the recognition and use of math coprocessors if available on your computer

reports program - a new reports program that allows users to print or display calculations without leaving ASEAM. Reports can be changed or added without having to recompile ASEAM3.0. This new feature is described fully in Chapter 12, Section 12.5.8.

increased zones - the number of thermal load zones has been increased to 15.

parametric processor - the parametric processor feature has been improved to accomodate coordinated changes in parametric input variables. This feature is described in more detail in Chapter 11, Section 11.5.

color screens - the ASEAM3.0 screens are now displayed in color.

new life-cycle cost - the old ASEAM2.1 life-cycle cost programs, FBLCC and BLCC, have been replaced by a single new version - BLCC. The new BLCC program is now integrated with ASEAM3.0.

The new documentation for ASEAM3.0 is generally the same as the original ASEAM2.1 User's Manual. Corrections to the User's Manual were made for the above new features or improvements. All existing ASEAM2.1 input files will work with the new ASEAM3.0 version. However, any existing ASEAM2.1 systems input files should be edited with the new ASEAM3.0 Systems Input program, since there is a slight change in the input data file structure.

1.3 How to Use This Manual

This manual is a user's manual. It is not a programmer's manual or an HVAC engineering manual. It is assumed that you have a working knowledge of the operation of your computer and a basic understanding of HVAC and building energy analysis principles. therefore, this manual does not describe how to format diskettes, copy files, or calculate U-factors.

This User's Manual is divided into three sections: Using ASEAM3.0 (Chapters 1 through 4), Reference Section (Chapters 5 through 12), and the Appendix.

Using ASEAM3.0

Chapter 1, Introduction, briefly describes ASEAM3.0's features and how the program works. The organization of the manual and diskettes is described, and instructions provided concerning what to do if errors are suspected.

Chapter 2, Getting Started, describes the hardware requirements and suggests optional equipment and software for using ASEAM3.0. This chapter also explains how to install and use ASEAM3.0 on a hard disk.

Chapter 3, Using ASEAM3.0, provides step-by-step instructions for using ASEAM3.0. You will learn how to start ASEAM3.0, select menu options, enter and edit input data, print reports, specify analysis, and run calculations. Files contained in the data subdirectory will be used.

Chapter 4, Modeling with ASEAM3.0, outlines a step-by-step procedure for modeling both existing and new buildings, followed by a brief discussion on zoning a building.

Reference Section

Chapter 5, Loads Input, describes the input screens and the questions for which you will supply data necessary to calculate peak and diversified zone heating and cooling loads in the building.

Chapter 6, Systems Input, describes the secondary systems simulated by ASEAM3.0 and the input screens and questions pertaining to the systems.

Chapter 7, Plant Input, describes the input questions necessary to model a building's central heating and cooling plants.

Chapter 8, ECO Input, describes how ASEAM3.0 can be used to model ECOs (Energy Conservation Opportunities). The input screens for the ECOs and a general description of their use can be found in this chapter.

Chapter 9, Quick Input, describes the features and limitations of the "quick" input program. Input screens for this program are also described.

Chapter 10, Building Life-Cycle Cost Program, explains how to use the NIST Life-Cycle Cost programs (BLCC) with ASEAM3.0. This program is first run separately (without ASEAM3.0) to generate input data files for the calculations. If you specify a BLCC input file during the calculations, ASEAM3.0 will automatically perform the BLCC calculations following an ASEAM3.0 run, and then substitute the ASEAM3.0 energy results into the BLCC data file before performing the BLCC calculations.

Chapter 11, Specifying Analyses, describes the various modes of performing ASEAM3.0 calculations and the input screens and questions required to specify the types of analyses and outputs you desire.

Chapter 12, Output Reports, contains samples of each of the output reports and calculation displays available.

APPENDIX

Appendix A, Weather and Solar Data, describes the file structure of ASEAM3.0's weather and solar files. You will also learn how to create new weather and solar files, and how to change the data in these files.

Appendix B, Input Screen Forms, includes copies of all input screens for ASEAM3.0 input programs.

Appendix C, Changing Input Screen Parameters, shows you how to change ASEAM3.0 input screens: what is displayed on the screen, field length, error check type and limits, default values, and help messages.

Appendix D, Changing ASEAM3.0 Source Code, describes how to make source code changes in ASEAM3.0.

Appendix E, ASEAM3.0 Files, briefly describes all files contained in ASEAM3.0. Their purpose and their relationship to other files are also described.

Appendix F, Suggested References, lists additional references that can be helpful when using ASEAM3.0.

Appendix G, Quick Input Default Files, shows you how to change the default values used by the Quick Input program.

1.4 Abbreviations and Terminology

Several abbreviations used in this manual and in the program are explained below.

1. Fx (where x represents a number from 1 to 10)

   Press the function key "x" (e.g., F5) to make ASEAM3.0 perform the listed function. Menus defining the function of these keys appear throughout the input screens and calculations.

2. ` ' (characters or numbers enclosed in single quotation marks)

   By entering the text or numbers within the single quotation marks, ASEAM3.0 will interpret your entry to mean the listed function. *Do not include the quotation marks in your entry.*

3. CR (Carriage Return)

   The abbreviation CR indicates that you should press the "Enter" key. You may also see this referred to as the "ENTER," "Carriage Return," or "Return" key.

4. NA (Not Applicable)

   "NA" is often an appropriate response to certain input questions. If you enter NA in response to such questions, ASEAM3.0 interprets this to mean that input questions associated with and following this entry are not applicable. The NA response inhibits data entry and error checking for the associated questions.

5. Opt (Optional)

   Some data entry questions are not used for calculations, but rather are for your reference only. There is no need to enter data for those items marked optional.

1.5 User's Background and Intended Audience

As stated above, the authors of this manual assume that you understand the operation of your computer as well as basic HVAC principles. Technical input questions are described in detail in this manual. In the systems and plant input

segments especially, default values are available by using function key F8. Using function key F9 for "help" during loads input will generally indicate the reference sections pages in the ASEAM3.0 User's Manual or the 1985 ASHRAE Handbook of Fundamentals or in the User's Manual.

Although ASEAM3.0 can be used by anyone interested in building energy analysis, it includes features that are particularly useful to educators, researchers, and federal energy managers. Many other fine programs are available that include automatic cost estimating and text reports for ECOs, more capabilities (e.g., number of zones, systems, and plant types modeled), less calculation time, and additional user-friendly features. The emphasis in the design of ASEAM3.0 has been to:

- show the engineering calculations;
- provide an easy means of investigating the effects of changes in input variables through the parametric processor and ECO modes of calculation;
- provide readable, structured source codes that can be changed.

1.6 ASEAM3.0 Calculation Overview

Like most building energy analysis programs, ASEAM3.0 performs calculations in four segments:

Loads: Thermal heating and cooling loads (both peak and "diversified," or average) are calculated for each zone by month and outside bin temperature. Lighting and miscellaneous electrical consumption is calculated in the loads segment.

Systems: The thermal loads calculated in the loads segment are then passed to the systems segment, which calculates "coil" loads for boilers and chillers. Note that the system coil loads are not equal to the zone loads calculated above owing to ventilation requirements, latent cooling, humidification requirements, economizer cycles, reheat, mixing, etc. Some building energy requirements are calculated in the systems segment (e.g., heat pump and fan electricity requirements).

Plant: All of the systems coil loads on the central heating and cooling plant equipment are then combined, and calculations are performed for each central plant type. Note that plant equipment can also impose loads on other plant equipment, such as cooling tower loads from chillers and boiler loads from absorption chillers or domestic hot water. The results of the plant calculations are monthly and annual energy consumption for each plant type.

Economic (optional): Energy consumption from all the building end-use categories is then totaled and reported. If specified, the life-cycle costs of the total energy requirements, combined with other parameters, are calculated and reported. Comparisons of base case with alternative cases may also be performed in the parametric and ECO calculation modes.

1.7 Steps in Using ASEAM3.0

To do a building energy analysis using ASEAM3.0, several steps are required (see Chapter 4 for further details).

1. The input data necessary for modeling the building must first be collected or determined.

2. Data are entered for the loads segment, such as building component areas and U-factors, internal gains, and occupancy schedules.

3. Data are entered for the systems segment, such as system types and HVAC control setpoints.

4. Data for the plant segment, which includes data on boilers and chillers, as well as energy costs are entered.

5. Life-cycle cost (LCC) information (optional) can be entered in BLCC input programs.

6. Runs to be done are defined in the Specify Analyses segment of the program.

7. The calculations are performed.

1.8 ASEAM3.0 Contents

In addition to this manual, you should have received several diskettes that contain the ASEAM3.0 executable code, BASIC source code, and weather and solar data files. On each of the diskettes are one or more large self-extracting files that, when executed, expand into the ASEAM3.0 files. In addition, a 'README.BAT' file and installation batch file are located in Disk #1. Installing ASEAM3.0 is covered in Chapter 2.

1.9 Errors

Every attempt has been made to provide you with "bug-free" programs. If, however, you experience errors when using ASEAM3.0, please contact: ASEAM Coordinator, ACEC Research & Management Foundation, 1015 15th Street, N.W., Suite 802, Washington, D.C., 20005.

You can encounter three types of errors when using ASEAM3.0:

Program errors relate to how you use ASEAM3.0. For example, if you enter incorrect input data or attempt to exit a screen with incorrect or missing data, ASEAM3.0 will alert you to the error in three ways:

1. The computer will beep, indicating an error has been detected.

2. An error message will appear at the bottom of the screen for two seconds.

3. ASEAM3.0 will return to the input question with the error.

During the input programs ASEAM3.0 detects such errors as "Disk Full" and "Printer Not Ready." These errors should not cause the program to abort or result in any loss of work. See Appendix C for instructions on how to change ASEAM3.0's error-checking limits for the input screens.

During the calculations, however, only limited printer errors are "trapped" and corrected. Most typically, when a condition exists that causes ASEAM3.0 to abort, you will be given a brief message of the error number and the line number of the BASIC program where the error was detected. You must look up the error in the BASIC source code and correct it before continuing. You must, unfortunately, start over with the calculations.

Computer errors, such as damaged diskettes or hardware problems, are beyond the control of ASEAM3.0. Refer to your computer manual or DOS manual and correct the problem before proceeding.

Modeling errors may occur when you misinterpret an input question and get seemingly erroneous results from ASEAM3.0. For example, you may have entered values in "feet" instead of "inches" for exterior window shading. These are the most difficult errors to find and correct. ASEAM3.0 can only perform the energy calculations with the data you supply. Insure that all data is entered correctly before assuming errors exist in the calculation algorithms.