THE DOE–2 USER NEWS

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DOE-2: A COMPUTER PROGRAM FOR BUILDING ENERGY SIMULATION

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☞ ☞ HANDS ON ☜ ☜

☞ DOE-2 Basics from NTIS !

DOE-2 Basics, a manual for new users, should finally be available from the National Technical Information Service. As of mid April, NTIS had not assigned a price, so you will have to call them. Check the order form in this newsletter.

This work was supported by the Assistant Secretary for Conservation and Renewable Energy, Office of Building Technologies, Building Systems and Materials Division of the U. S. Department of Energy, under Contract No. DE-AC03-76SF00098.

☞ CALENDAR ☜

June 10-12 — *Building Systems Automation Integration '92*
to be held in Dallas, Texas.
Contact: BSA-I '92, 13253 N. La Montana Drive, #205, Fountain Hills, AZ 85268 (phone 602-837-6575, FAX 602-837-6580).

June 10-11 — *HVAC Controls and Energy Conservation Exposition*
to be held in Boston, Massachusetts.
Contact: Association of Energy Engineers, 4025 Pleasantdale road, Atlanta, GA 30340.

June 27-July 1 — *Annual ASHRAE Meeting*
to be held in Baltimore, Maryland.
Contact: ASHRAE Meetings Department, 1791 Tullie Circle NE, Atlanta, GA 30329 (phone 404-636-8400).

July 4-8 — *Renewable Energy: Technology for Today*
to be held in Edmonton, Alberta, Canada.
Contact: Solar Energy Society of Canada, 15 New York Street, Ottawa, ON K1N 5S7, Canada (613-236-4594, FAX 613-236-5053).

Aug 30-Sep 5 — *ACEEE 1992 Summer Study on Energy Efficiency*
to be held in Pacific Grove, California.
Contact: ACEEE, 2140 Shattuck Avenue, Berkeley, CA 94704 (phone 510-549-9914, FAX 510-549-9984).

(HANDS ON is continued on p.16)

New Features in DOE-2.1E

A new version of the DOE-2 program, 2.1E, will be available mid-1992. It will replace DOE-2.1D, which was released in 1989. Ordering information will be mailed to User News subscribers as soon as DOE-2.1E is ready for distribution. Major new features in 2.1E are:

BDL

— User-specification of days where holidays fall.

LOADS

— Switchable glazing simulation.

— New Window Library:

- solar-optical and thermal properties of 200 currently-available glazings, including low-E, gas fill, heat mirror, superwindows.

— Custom glazings:

- option to add custom glazings to the Window Library by running the WINDOW-4 program with layer-by-layer input.

— Improved window U-value calculation:

- integration of the very accurate WINDOW-4 calculation of window conduction and solar gain (includes window frame calculation).

SYSTEMS

— Evaporative cooling:

- stand-alone evaporative cooling system (choice of indirect or indirect/direct);
- add-on evaporative pre-cooler for conventional systems;
- residential direct evaporative cooler.

— Add-on desiccant cooling units:

- solid desiccant dehumidifier;
- liquid desiccant dehumidifier;
- liquid desiccant dehumidifier combined with gas-fired absorption chiller.

— Heat pump water heaters:

- additional air-side economizer options;
- combined enthalpy/drybulb controller;
- economizer lockout controls.

This new version of DOE-2 was collaboratively developed by the Simulation Research Group at LBL and by Hirsch & Associates of Camarillo, CA. Support was provided by DOE (Office of Building Technologies), Southern California Edison Company, Pacific Gas and Electric Company, Electric Power Research Institute, Gas Research Institute (via ElectroCom GARD, Ltd.), Battelle-Pacific Northwest Laboratory, and IEA Solar Heating and Cooling Program.

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— Additional heat pump defrost options:
  - resistive or reverse-cycle defrost with on-demand or timed control.
— Sizing enhancements:
  - independent SIZING-RATIOs for heating and cooling;
  - summary of design-day SYSTEMS sizing (SS-J design-day report);
  - loads-not-met flags added to SS-J as indicator of undersizing.
— Variable-speed gas heat pump.
— Packaged VVT System.
— Residential system with individual zone control and variable-speed electric heat pump.
— Enhanced water-loop heat pump model:
  - variable-speed and scheduled pumping;
  - storage tank, boiler, and cooling tower in SYSTEMS;
  - air-side and water-side economizer;
  - units with different performance characteristics on same loop.
— Water-side economizer for packaged systems.

PLANT

— Ice thermal energy storage:
  - different types: ice-on-coil, ice harvester, ice slurry, brine, eutectic salt;
  - auto-sizing based on peak-day integrated cooling load;
  - various control options, including full vs. partial storage and storage vs. chiller priority.
— Option of design-day vs. weather tape PLANT sizing.

ECONOMICS

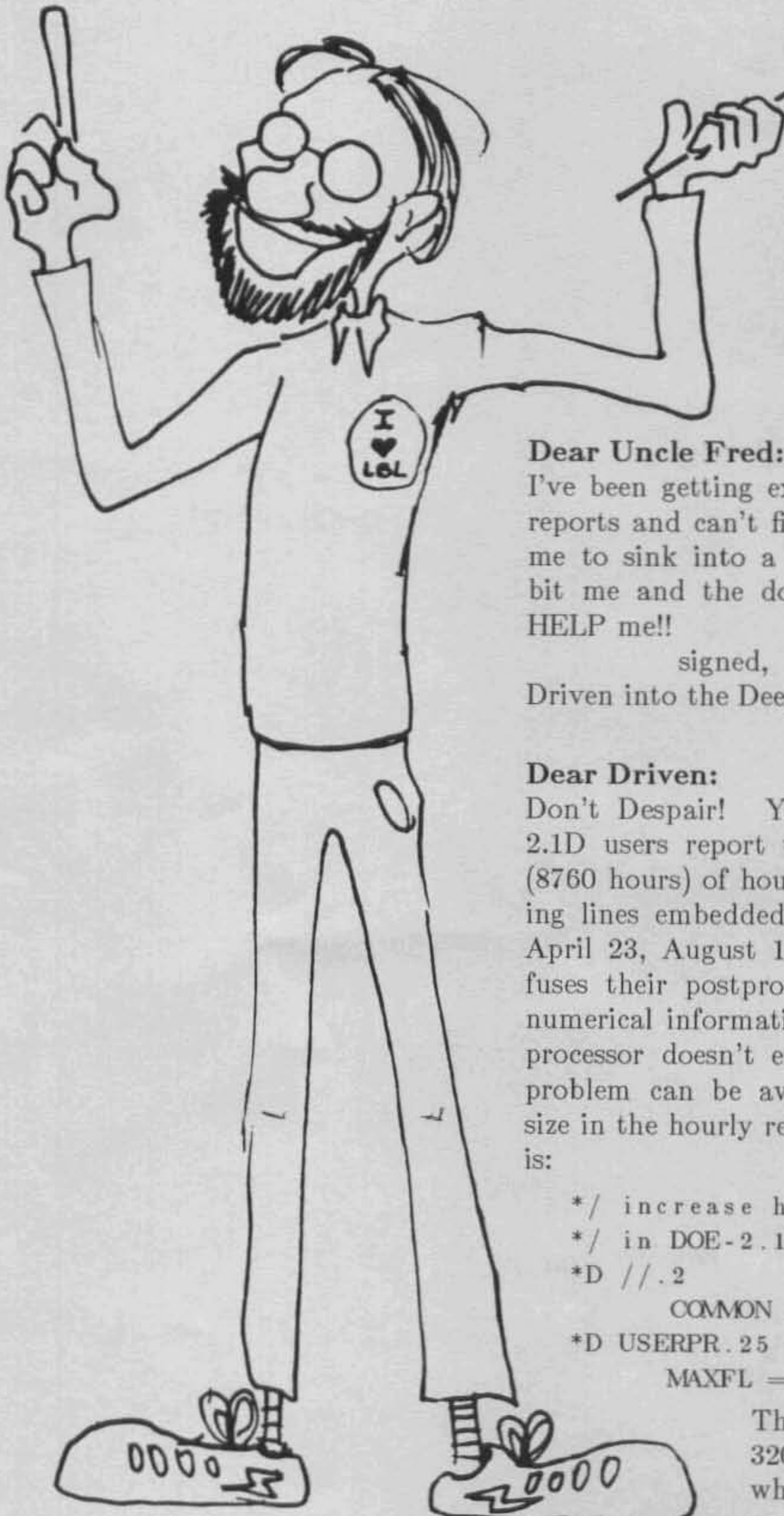
ECONOMICS has been rewritten to handle utility rate structures that are more complex than the current program can handle.

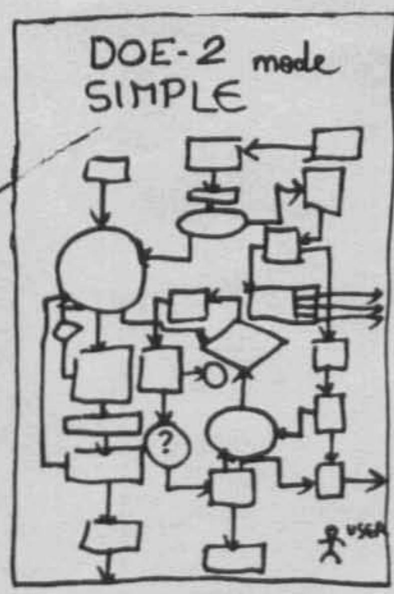
— New capabilities include:
  - more than two seasons;
  - separate rates for the same resource (multiple electric and fuel meters);
  - ratchets that apply over a variety of time frames (on-peak, off-peak, etc.).

LOADS/SYSTEMS/PLANT

Hourly and monthly disaggregation of electrical and fuel energy consumption into different end uses (area lighting electric, task lighting electric, cooling electric, heating fuel, cooling fuel, etc.).

■ ■ ■ Ask Uncle Fred ■ ■ ■





Dear Uncle Fred:

I've been getting extra heading lines in my hourly reports and can't figure out why! This has caused me to sink into a deep depression. My wife just bit me and the dog left home yesterday. Please HELP me!!

signed,

Driven into the Deep DOE-2 Doldrums in Duluth

Dear Driven:

Don't Despair! You're not alone; several DOE-2.1D users report that when printing a full year (8760 hours) of hourly reports they get extra heading lines embedded among the numerical data on April 23, August 14, and December 4. This confuses their postprocessor plotting programs: the numerical information is still correct but the postprocessor doesn't expect the extra headings. This problem can be avoided by increasing the buffer size in the hourly report program. The fix, to HRP, is:

```
*/ increase hourly report buffer size
*/ in DOE-2.1D
*D //.2
      COMMON AA(200000)
*D USERPR.25
      MAXFL = 180000
```

This increases the buffer size from 32000 to 180000 and will allow a whole year of one page of hourly report data to fit in the buffer.

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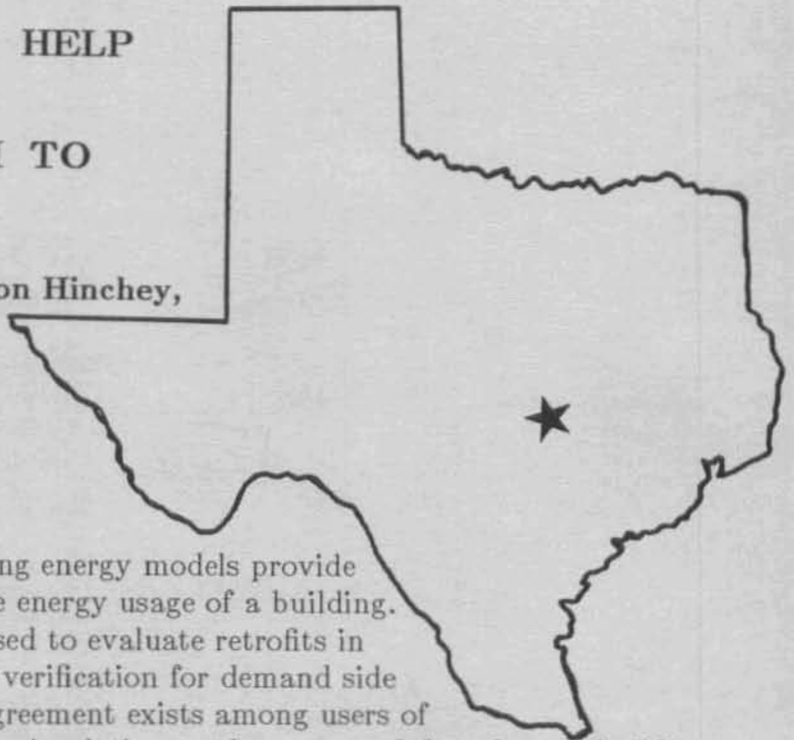
GRAPHICAL TOOLS TO HELP CALIBRATE THE DOE-2 SIMULATION PROGRAM TO MEASURED LOADS



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Mechanical Engineering
Texas A&M University
College Station, Texas 77843

Introduction

During the design stage hourly building energy models provide an effective method for simulating the energy usage of a building. Increasingly, such models are being used to evaluate retrofits in existing buildings, sometimes even as verification for demand side management. Unfortunately, little agreement exists among users of the models about how to calibrate the simulation to the measured data from a building.

This article provides a sampling of several graphical tools we've developed for calibrating DOE-2 to measured loads. The procedure relies on comparative 3-D graphics and carpet plots that allow for hourly differences to be viewed over the entire simulation period. The reader is referred to the additional papers for more details (BRONSON 1992).

Methodology

In general we use a multi-step, iterative procedure to calibrate DOE-2 to measured energy use for a specific building. A method that seems to yield good results is to extract DOE-2's hourly data for pre-specified variables, translate the data into a contiguous columnar ASCII format, merge it with measured data for the same period, and then compare the simulated hourly variable to its measured counterpart using various graphical and statistical techniques.

The simulations performed for this article were done on a super-minicomputer cluster using DOE-2.1D. In addition to DOE-2, other supporting software is also needed, depending on what is to be done and the volume of data to be handled. 2-D and 3-D plotting programs with good data handling capabilities are mandatory for viewing the data. The procedures described here are specific to the graphics packages used to produce the plots, yet we feel they are general enough to be of value for use with other packages.

DOE-2 contains many input variables that can be adjusted during the calibration process. One convenient grouping is to consider weather dependent and non-weather dependent input variables. Weather dependent variables include energy that is consumed for space heating/cooling purposes; non-weather dependent energy use includes energy used for loads that are primarily schedule dominated (i.e., lights and receptacles). As one would expect, there is some overlap between the two categories. This weather dependent and non-weather dependent categorization agrees well with monitored data from buildings, especially when data are being measured for the whole-building electricity and thermal energy use, and sub-metered data are available for the motor control centers, and other important subsystems.

Figure 1 is a flow chart of the overall DOE-2 calibration procedure. Our primary sources of information include as-built drawings, audit reports, information from on-site visits, and monitored data. A DOE-2 input deck is produced for each building and measured weather data are converted to suitable units, overlaid onto the TRY weather tape for a local site, and repacked for use with DOE-2 using the weather processing utilities that come with the program.

Figure 2 is a software diagram that shows the different modules required to produce the different plots. In general, hourly values are extracted from DOE-2, translated to a common columnar format and compared to the measured data. This process is then repeated until the difference between the simulated and measured data fall within an acceptable range.

As much as possible, public domain procedures were used to hold down costs and to facilitate the development and distribution of software that others can use. Beginning in the upper left-hand corner measured non-weather dependent electricity consumption data and weather data are extracted from the main file and prepared for insertion into DOE-2 input. The non-weather dependent data are condensed into day types using a day-typing routine (KATIPAMULA 1991) and the resultant information inserted into the DOE-2 schedules which are then multiplied by the appropriate scaled load density (e.g., W/ft2) for each variable.

The DOE-2 input deck and hourly weather data were then transferred from the microcomputer to the super-minicomputer cluster on which the DOE-2 program resides. The measured weather data did not embody all the meteorological and insolation parameters required in a TRY weather file; therefore, an additional weather preprocessing program was used to derive certain weather parameters from the measured data and convert into the proper input units (i.e., horizontal solar was split into a direct normal and diffuse components) and "repacked" into a TRY format weather file using the FORTRAN weather processing program that is included with DOE-2.

A DOE-2 simulation was then run on the superminicomputer cluster with the "repacked" TRY weather tape and the input file that contained the actual non-weather dependent electric load profiles which had been entered as schedules. The simulation output file was transferred back to the PC, where hourly values were extracted and plotted from each run. Each time a different aspect was being considered, it was necessary to edit the DOE-2 input deck, transfer the DOE-2 input deck to the superminicomputer for processing and transfer the DOE-2 output back to the PC and extract and manipulate the hourly output for the preparation of the necessary graphics. At first, this process was very tedious and error prone and considerable effort was spent automating the procedures. In order to facilitate automation in the face of varying file formats it was decided to develop modules that could be quickly linked together into the desired configuration for each run. See (BRONSON 1992) for information on the modules.

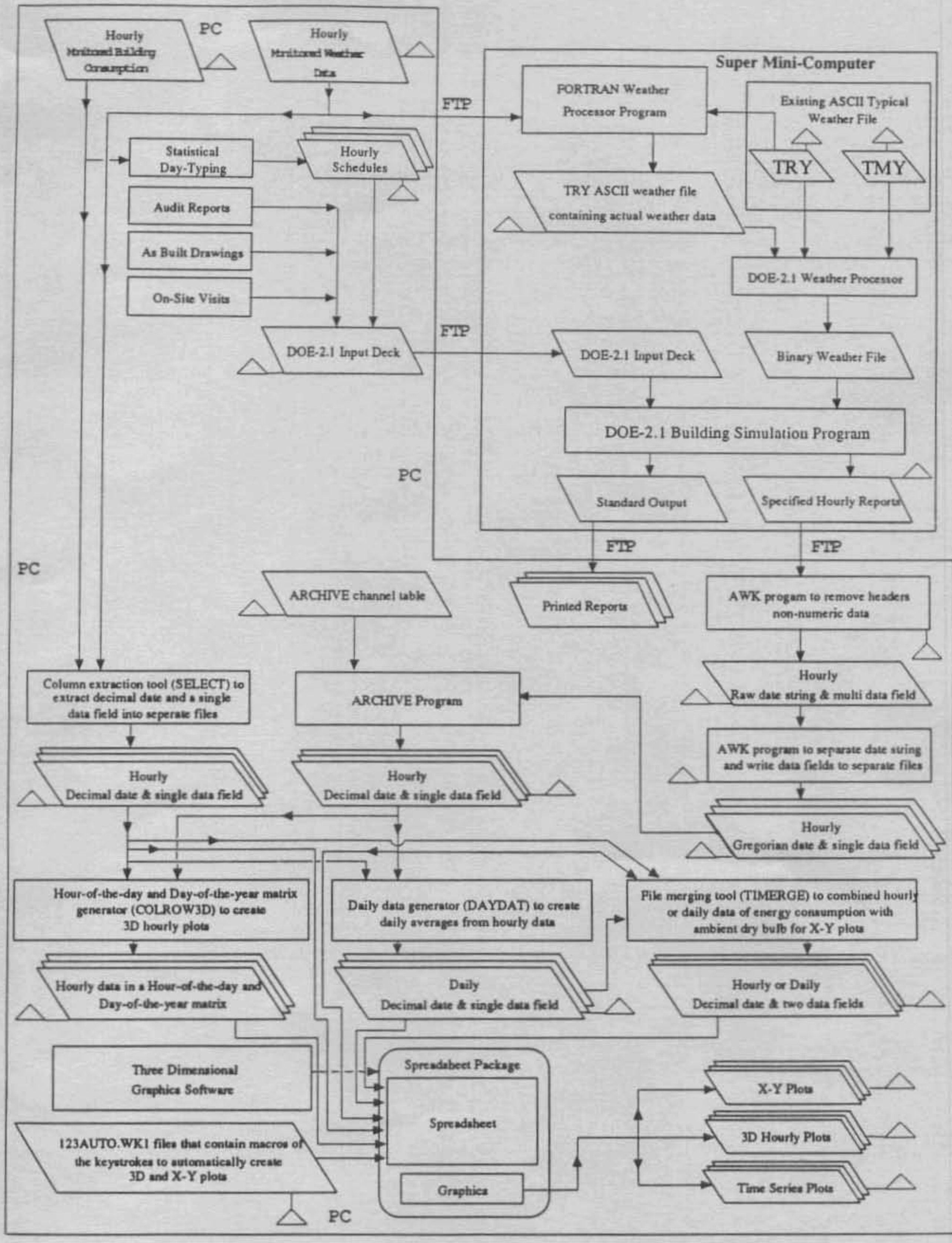

Figure 1 Flow diagram for the calibration procedure.

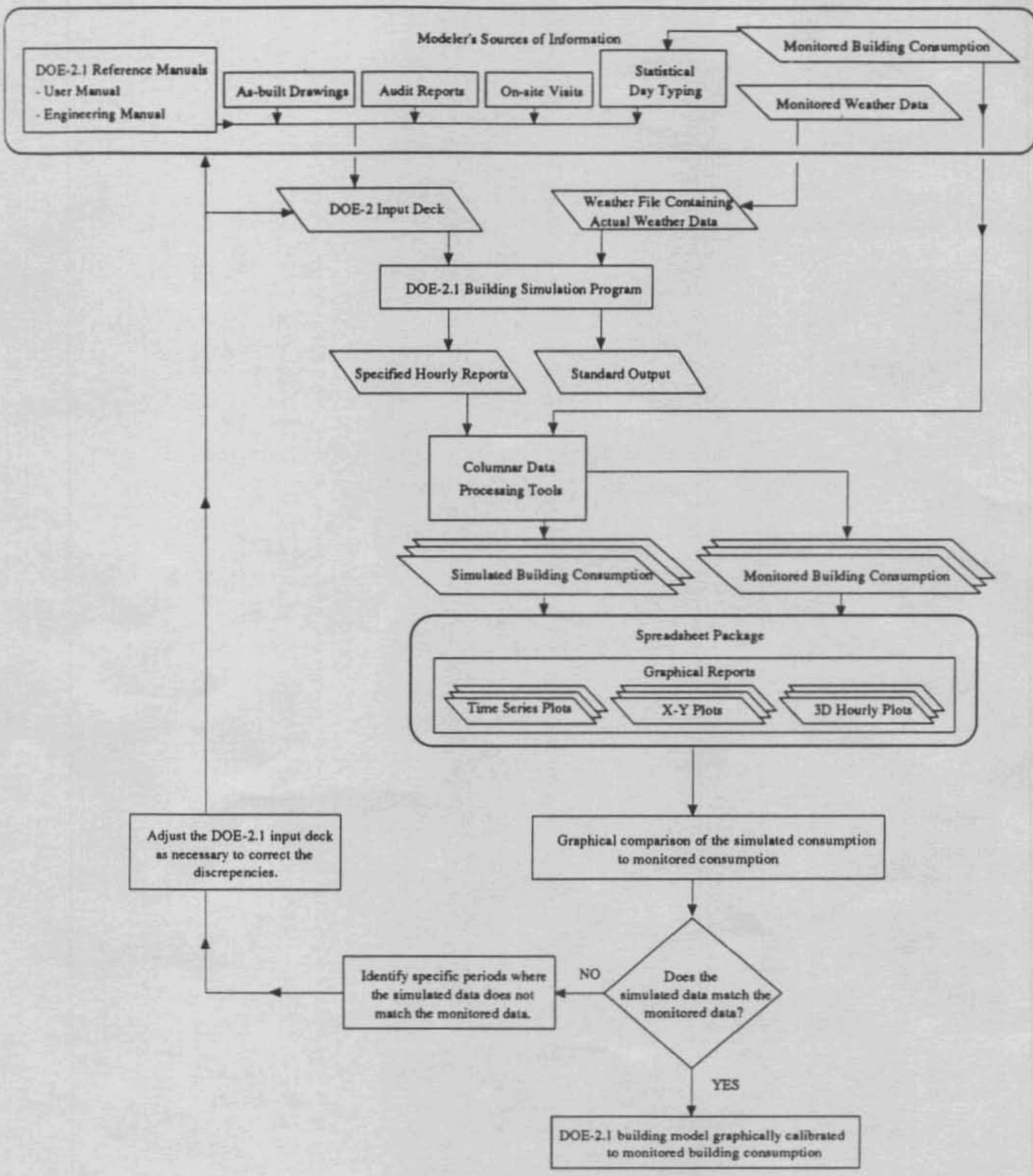

Figure 2 **General flow diagram for producing the graphics.**

Application

The procedure was applied to a case study building: the Engineering Center is a large, multi-purpose building which contains classrooms, laboratories, faculty/staff offices, and a large central computer facility; it is located on the Texas A&M University campus in central Texas about two hours Northwest of Houston. The Engineering Center receives steam, hot water, chilled water, electricity, and communication services from a centralized utility distribution system. The four story, 324,400 square foot facility was built in the early 1970's. The building measures 339 feet (the long axis) by 221 feet and is 60 feet in height. Parking is provided under the facility for 82 cars. The building can be characterized as an internal load dominated, high mass structure. Only about 9% of the exterior envelope is glazed. The building has a maximum occupancy of 2,300 occupants which occurs during peak periods each semester. The occupancy profiles are characterized by an 8 a.m. to 7 p.m. weekday schedule. Significant evening usage of the building occurs on weekdays between 7 p.m. and midnight during semesters. Weekend usage is moderate. Internal lighting loads (2 W/ft^2) and equipment loads (2.4 W/ft^2) peak during the weekdays in the early afternoon. Considerable electricity is consumed in the evenings by a central computing facility. The building has 12 constant volume, dual-duct AHUs which continuously provide 330,500 CFM to the 90+ zones in the building. The AHUs are located in the parking garage with return air paths provided by concrete chaseways that encircle the exterior of the building.

Results

To demonstrate this procedure, statistically derived day-types were created for the building and input into DOE-2. The resultant simulated profiles for the non-weather dependent loads were then compared to hourly measured data from the building using 3-D comparative plots produced with a spreadsheet add-on package. Energy use for the building's lighting and equipment loads (or receptacle loads) was input as a W/ft^2 value and scheduled according to different day types (e.g., Mon-Fri, and Weekends and Holidays). The application of a simple hourly day-typing routine by Katipamula and Haberl (KATIPAMULA 1991) to hourly data from a six-month data set yielded six primary day-types (K-H day types): fall weekdays and weekends, spring weekdays and weekends, and semester-break weekdays and weekends. Spring and fall day types were necessary because, during the break between semesters, the entire Computer Science department moved out of the building and into their newly constructed facilities in a different building, with the remaining space being reallocated to previously cramped departments.

3-D plots for the day type profiles are shown in Figure 3. Three dimensional profiles are an effective method of presenting the enormous amount of data that must be inspected when one is viewing hourly data over a six month period (HABERL 1988). Small differences among different data sets can be quickly identified because the viewer can spatially compare the individual features or "small multiples" that the surfaces produce (TUFTE 1990). The 3-D plots display hour-of-the-day along the x-axis and day-of-the-year projecting into the page (beginning with September 1989 in the lower right corner and proceeding from right to left). The energy use is the height of the surface above the x-y plane. Comparing the minute differences between two surfaces can be further enhanced with the use of 3-D comparative plots (HABERL 1990). 3-D comparative plots

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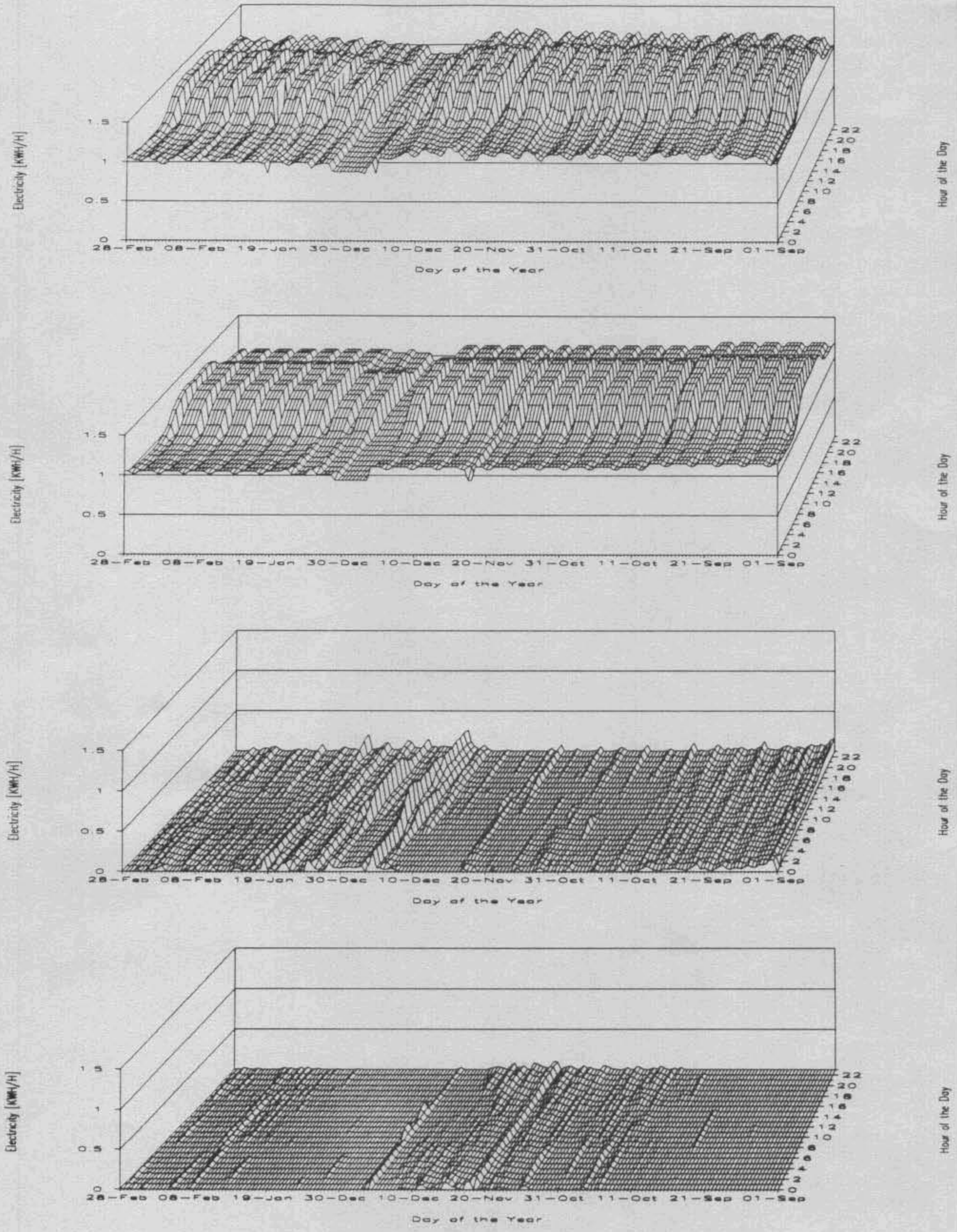

Figure 3 **3-D Comparative plots using the K-H day types from the full data set.**

are produced by merging two surfaces into positive and negative residuals. For example, in Fig. 3 the upper graph represents the actual measured data for the building and the second graph represents the day type schedule based on statistical day types. The third graph represents the positive residual (i.e., simulated - monitored data for values that are greater than zero), and the fourth graph is the absolute value of the negative residual (i.e., monitored - simulated data). Both positive and negative residuals are trimmed at zero to enhance the features.

Figure 3 shows the comparison between the electricity use predicted by the K-H day types and measured electricity consumption for the same period. Clearly, as seen in the residual plots, the use of simple day types yield a shape that accurately fits the hourly data for the building. Only a few days during the Christmas break requires further adjustment. The day types also provide a good estimate of the monthly electricity use, yielding estimates that differ from -3.3% to +4.0% for the six months that were investigated. Several other day-typing routines as well as the special adjustments necessary to DOE-2 are discussed in the paper by Bronson et al. (BRONSON 1992).

For weather dependent calibrations, especially in central Texas where a significant portion of the building's cooling load was latent cooling, it was determined that a series of plots would be the most useful. Specifically, an hourly scatter plot of energy use versus ambient temperature, a "mapping" of the energy use onto a psychrometric chart, histograms showing the occurrences of data in both temperature and specific humidity bins, energy use versus specific humidity, day type plots, and time series traces of all variables. Also, it was determined that aligning the different graphs around the psychrometric chart helped improve the impact of the comparative graphic.

Figure 4 illustrates the carpet plot that was developed for this purpose. The term "carpet plot" is used because the axis of the graphs are linked by common variables (TUKEY 1988). The nine plots which make up the carpet plots in Figure 4 were all plotted with the same software package, varying only the graphical template. In each row of plots, the center column of plots contain the outdoor dry bulb temperature as the x-axis. The three upper plots all have the building's energy use along the y-axis. The upper left-hand plot contains cooling day type profiles and electricity profiles for weekdays and weekends for conditions above and below 60F. The middle plot in the upper row shows heating and cooling energy use versus outdoor dry bulb temperature. A simple 2 parameter (slope and intercept) curve fit has been added to show the central tendency of the data points. The upper right-hand plot displays the cooling and heating energy use as a 2-D time series plot for the period under investigation, and the lower right-hand plot shows the time series trace for the temperature and humidity data. In the center plot in the middle row, the position of each hourly point is displayed on a psychrometric chart. Directly to the right of the psychrometric plot is a histogram that displays the numbers of hours for 10 specific humidity bins. Directly below the psychrometric chart is a histogram that displays the number of hours for 22 temperature bins. Even though the initial set up of these plots was tedious, once in place, they proved very useful in determining very fine differences in the progression of the weather calibration of the DOE-2 simulation. Additional reports concerning how these carpet plots have been used to assess the impact of different weather input files are available from the authors.

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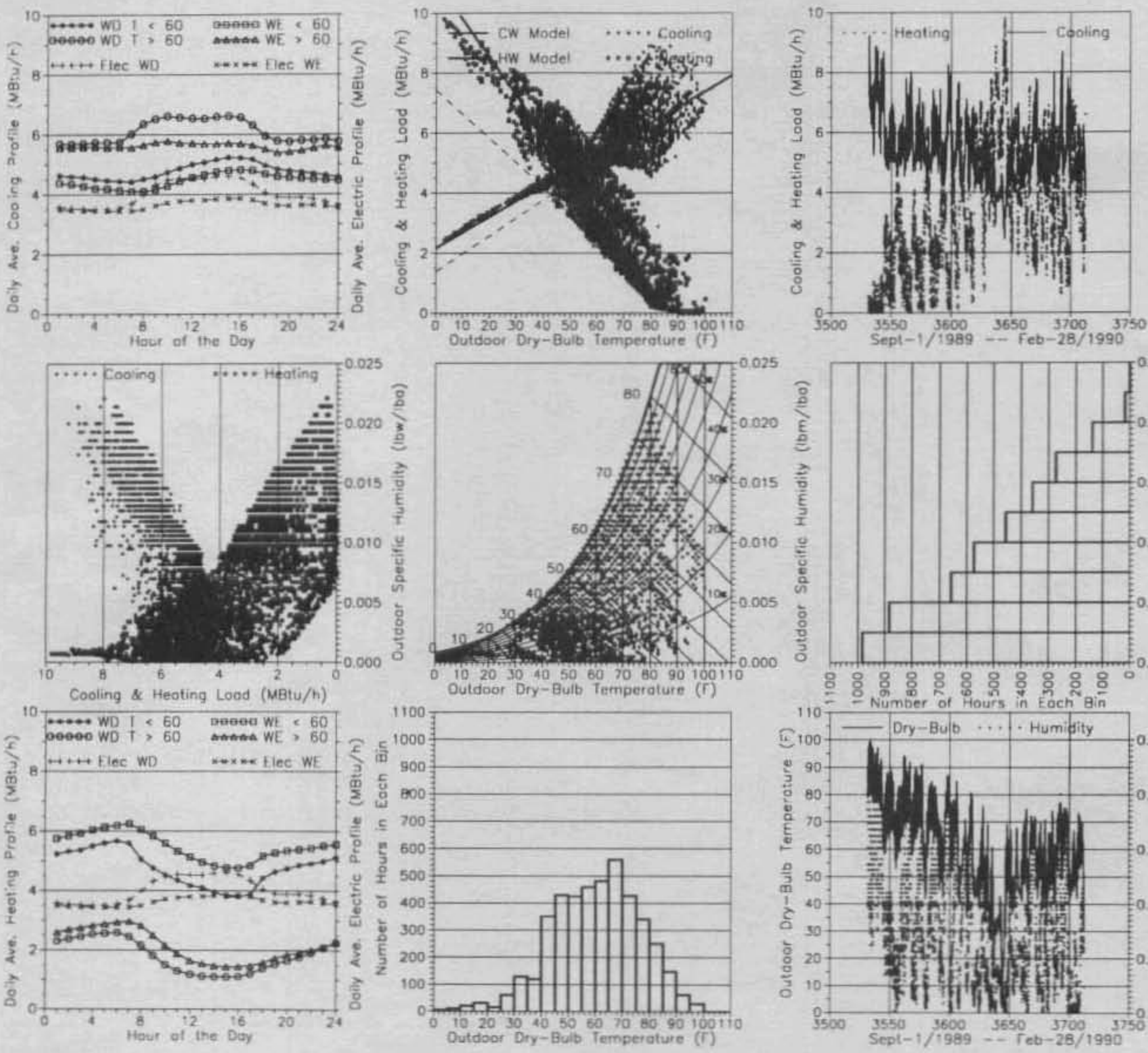

Figure 4 DOE-2 simulated energy usage using "packed" TRY weather data.

Discussion

This article has briefly introduced several public domain graphical tools for calibrating DOE-2 to measured loads. The procedure relies on comparative 3-D graphics and carpet plots that allow for hourly differences to be viewed over the entire simulation period (8,760 data points if necessary). Examples of each of the primary graphical tools have been provided. The availability of comparative 3-D surface plots and carpet plots significantly improves the ability to view small differences between the simulated and measured data and, in turn, allowed for the creation of a "super-tuned" DOE-2 simulation. Automation of these routines dramatically cuts down on the processing time needed to produce a set of plots. Use of these compact graphical tools to calibrate DOE-2 can also avoid the needless printing of thousands of pages of DOE-2 output.

Acknowledgments

This project was funded and supported by the Governor's Energy Office of the State of Texas as part of Texas A&M's LoanSTAR Monitoring and Analysis contract using oil overcharge funds. Further funding and support was provided by the Texas Higher Education Coordinating Board under Project #227.

Software used during the course of this project includes:

- Data Exploration software from Lantern Corporation, Clayton, Missouri
- Lotus 1-2-3 Spreadsheet (V2x)
- Grapher and Surfer software from Golden Software, Golden, Colorado
- 3-D, 123 add-on package from Intex Solutions, Needham, Massachusetts
- Statistical Analysis Software from the SAS Institute, Cary, North Carolina
- file transfer software from FTP Software Inc., Wakefield, Massachusetts
- ARCHIVE software, Feuerman, D., Kempton, W. 1987, "ARCHIVE: Software for the Management of Field Data", Center for Energy and Environmental Studies Report No.216 (FEUERMAN 1987)
- the GAWK columnar processing routines (FSF 1989)
- Postscript typesetting with TeX (TeX 1986)
- Copies of the public domain DOE-2 post-processing software used to produce the plots can be obtained from the authors

For information on the LoanSTAR program, please write or e-mail the authors (Bitnet: JSH4037@TAMSIGMA or Internet: jhaberl@loanstar.tamu.edu). Special thanks to Srinivas Katipamula, Dean Willis, Robert Sparks, and Robert Lopez for providing technical support.

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References

BRONSON 1992	Bronson, D., Hinchey, S., Haberl, J., O'Neal, D. 1992. "A Procedure for Calibrating the DOE-2 Simulation Program to Non-weather Dependent Measured Loads." ASHRAE Transactions, V.98, Pt.1.
FEUERMAN 1987	Feuerman, D., Kempton, W. 1987, "ARCHIVE: Software for the Management of Field Data", Center for Energy and Environmental Studies Report No.216, (This also includes Tony's Tools, and Art's Tools which are useful columnar data processing tools), Princeton University.
FSF 1989	FSF 1989. GAWK, Free Software Foundation (PC version of the Unix-based AWK toolkit), 675 Massachusetts Ave., Cambridge, Massachusetts 02139.
HABERL 1988	Haberl, J., MacDonald, M., Eden, A. 1988. "An Overview of 3-D Graphical Analysis Using DOE-2 Hourly Simulation Data", ASHRAE Transactions, Vol. 94, Part 1.
HABERL 1990	Haberl, J., and Komor, P. 1990. "Improving Commercial Building Energy Audits: How Daily and Hourly Consumption Data Can Help", ASHRAE Journal, September.
KATIPAMULA 1991	Katipamula, S., K., and Haberl, J., 1991. "A Methodology to Identify Diurnal Load Shapes for Non-Weather Dependent Electric End-Uses", Solar Engineering, 1991: Proceedings of the ASME-JSES-JSME International Solar Energy Conference, pp. 457-467, Reno, Nevada, March.
TeX 1986	TeX 1986. The TEXbook, Donald Knuth, The American Mathematical Society and the Addison Wesley Publishing Company, Reading, Massachusetts.
TUFTE 1990	Tufte, E. 1990. Envisioning Information, Graphics Press, P.O. Box 430, Cheshire, Connecticut, 06410.
TUKEY 1988	Tukey, J. 1988. The Collected Works of John W. Tukey. Volume 5: Graphics, 1965-1985, Wadsworth and Brooks/Cole Advanced Books and Software, Pacific Grove, CA, ISBN 0-534-05102-2.

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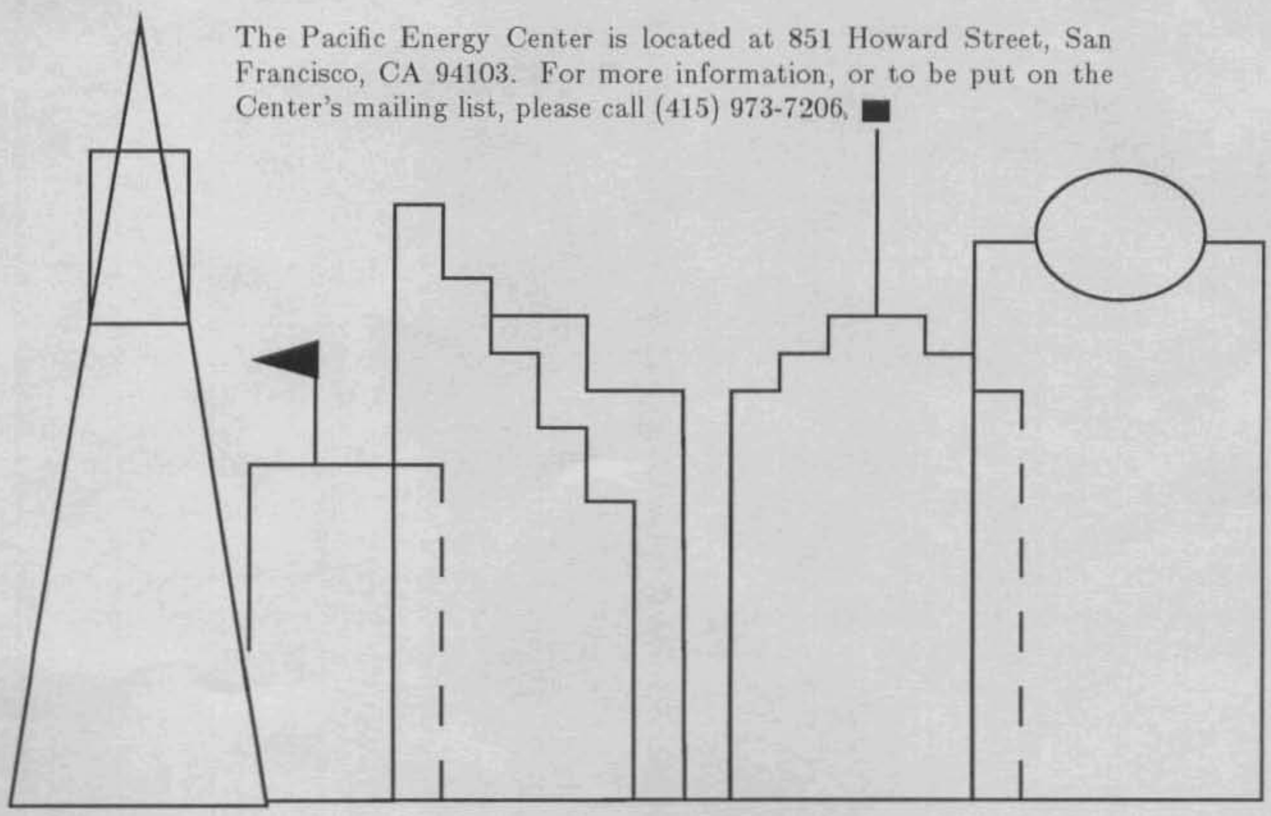
Pacific Gas & Electric's New Pacific Energy Center

The Pacific Energy Center in San Francisco is a resource center dedicated to saving energy through the use of efficient technologies and design techniques. Created as a gathering place for building professionals and residential and commercial customers, the Pacific Energy Center features working displays, practical laboratories and seminars on state-of-the-art energy efficient products and design techniques. The **Lobby** area features PG&E's **Challenge 2000 House**, an interactive energy-efficient exhibit aimed at residential customers. Resources available to design professionals include these:

- The **Resource Center** contains current information about energy efficient products and design techniques. Software and hardware are available for use.
- The **HVAC Classroom/Demonstration Laboratory** allows up to 40 people at a time study heating, ventilation and air conditioning equipment and systems.
- The **Lighting Classroom** features demonstrations of key concepts in lighting and perception theory and practice.
- The **Heliodon Station** combines an adjustable table, representing the earth, with a ceiling mounted light source, representing the sun, to simulate the effect of sunlight on a building at any time of the day or year.
- The **Daylighting Laboratory** lets architects and lighting professionals simulate the effect of daylight on a variety of spaces; the **Daylighting Model Testing Station** lets them build and test prototypes.
- The **Advanced Products Gallery** houses changing exhibitions of energy efficient products and equipment.

The Pacific Energy Center is located at 851 Howard Street, San Francisco, CA 94103. For more information, or to be put on the Center's mailing list, please call (415) 973-7206. ■



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☞ CIEE

In 1988, a statewide collaboration among California's six largest electric and gas utilities, the California Public Utilities Commission, the California Energy Commission, the University of California and Lawrence Berkeley Laboratory led to the creation of the California Institute for Energy Efficiency (CIEE). CIEE was specifically established to respond to the state's energy and environmental needs by using the scientific and technological capabilities of colleges, universities, and research laboratories to develop new energy efficient technologies for buildings, industry, and transportation. Its mission is to coordinate, plan, and implement a statewide program of applied research aimed at advancing the energy efficiency and productivity of all end-use sectors in California. In 1990, CIEE initiated eleven major multi-year research efforts in the fields of Building Energy Efficiency, Air Quality Impacts of Energy Efficiency, and End-Use Resource Planning. To request more information, publications, or to be put on their newsletter mailing list please write the California Institute for Energy Efficiency, Building 90 - Room 3124, Lawrence Berkeley Laboratory, Berkeley, CA 94720.

☞ CAREIRS in Energy!

The **C**onservation **A**nd **R**enewable **E**nergy **I**nquiry and **R**eferral **S**ervice (**CAREIRS**) provides information on the full spectrum of renewable energy technologies and energy conservation. CAREIRS maintains contact with a nationwide network of public and private organizations that specialize in highly technical or regionally specific information. If you need information about wind energy, active and passive solar, photovoltaics, solar thermal, wood heating, biofuels, ocean energy, etc., CAREIRS can provide fact sheets, brochures, and publication lists. In addition, they can refer you to the appropriate trade associations, Federal agencies, state and local organizations, etc. Call toll free at 800-523-2929 or write CAREIRS, P.O. Box 8900, Silver Spring, MD 20907.

■ ■ ■ ■ DOE-2 DIRECTORY ■ ■ ■ ■
Program Related Software and Services

■ ■ Source Code ■ ■

(2.1D VAX and SUN-4 Only)
Simulation Research Group
Bldg. 90, Room 3147
Lawrence Berkeley Laboratory
Berkeley, CA 94720 (510) 486-5711

(2.1C and 2.1D Mainframe Only)
Energy Science/Technology Software Center
Oak Ridge National Laboratory
P.O. Box 1020
Oak Ridge, TN 37831-1020 (615) 576-2606

(2.1D VMS, ULTRIX, SCO UNIX)
Finite Technologies, Inc.
821 N Street, #102
Anchorage, AK 99504 (907) 272-2714

■ ■ PC VERSIONS ■ ■

MICRO-DOE2 (DOE-2.1D for Microcomputers)
Acrosoft International (Gene Tsai)
9745 East Hampden Avenue
Denver, CO 80231 (303) 368-9225

FTIDOEv2.1D (DOE-2.1D for Microcomputers)
Finite Technologies, Inc. (see above for address)

ADM-DOE2 (DOE-2.1D for Microcomputers)
ADM Associates, Inc. (Taghi Alereza)
3299 Ramos Circle
Sacramento, CA 95827 (916) 363-8383

■ ■ Utility Programs ■ ■

DOE-Plus™ (Pre- and Post-Processor)
Building Blocks Software (Steve Byrne)
P.O. Box 5218
Berkeley, CA 94705-0218 (510) 549-1444

Graphs from DOE-2
Ernie Jessup
4977 Canoga Avenue
Woodland Hills, CA 91364 (818) 884-3997

COMPLY 24 – California Standards
Gabel Dodd Associates (Michael Gabel)
1818 Harmon Street
Berkeley, CA 94703 (510) 428-0803

Pre-DOE – (BDL math pre-processor)
Nick Luick
19030 State Street
Corona, CA 91719 (714) 278-3131

■ ■ VIDEO ■ ■

DOE-2 Instructional Video and Manual
Prof. Jan Kreider – JCEM
University of Colorado at Boulder
Campus Box 428
Boulder, CO 80309-0428 (303) 492-3915

■ ■ DOE-2 Training ■ ■

Mech. Engs., Consulting, Training
Marlon Addison
Energy Simulation Specialists
64 East Broadway, Suite 230
Tempe, AZ 85282 (602) 967-5278

■ ■ Weather Tapes ■ ■

TMY or TRY tapes:
National Climatic Data Center
Federal Building
Asheville, North Carolina 28801
Phone: (704) 259-0871 climate data
Phone: (704) 259-0682 main number

CTZ tapes:
California Energy Commission
Attn: Bruce Maeda, MS-25
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■ ■ User News ■ ■

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■ ■ ■ ■ DOE-2 PROGRAM DOCUMENTATION ■ ■ ■ ■

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		Cost of Documentation	
	NTIS Order No.	U.S.	Foreign
DOE-2 Basics Manual (2.1D)	DE-920-07955	??	??
BDL Summary (2.1D)	DE-890-17726	26.00	52.00
Sample Run Book (2.1D)	DE-890-17727	66.00	132.00
DOE-2 Supplement (2.1D)	DE-890-17728	59.00	118.00
Reference Manual (2.1A)	LBL-8706, Rev.2	115.00	230.00
Engineers Manual (2.1A) [algorithm descriptions]	DE-830-04575	50.00	100.00

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