Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720

DOE-2 USER NEWS
: A COMPUTER PROGRAM FOR BUILDING ENERGY USE ANALYSIS

PUB-439

Vol. 6 No. 1 SPRING 1985

Building Energy Simulation Group
Applied Science Division
Building 90, Room 3147
Telephone: (415) 486-5711
FTS: 451-5711

Table of Contents

The Daylighting Network 1
Microcomputer Update 2
A Heavy Workout for DOE-2 3
The Heat Exchanger 3

BULLETIN BOARD

Item: The DOE-2.1C version of the program is now available. Please call or write to us at LBL for details on obtaining the new program.

Item: How many people out there would be interested in a DOE-2 User Group? We hear from one of the major DOE-2 computer service bureaus that support is growing among their users for such an organization, and the bureau has expressed its willingness to sponsor a national group, open to all DOE-2 users. For a modest fee, the service bureau would plan the meeting dates and agendas, send out announcements, and provide the convention sites. If you are interested, please contact us at the above address and we will pass along the information.

Item: Summer isn't that far away, and with it comes the annual DOE-2 intensive course on the campus of the University of California at Berkeley. The three-day course, featuring the new 2.1C version of the program, will again be held in August, and will be instructed by primary authors of the code. They will be giving an overview of the use of the program in building energy analysis, and in-depth coverage of the new sunspace model, the PIU system, and changes in the PLANT and ECONOMICS programs. For more information, contact:

Continuing Education in Engineering
University Extension
University of California
2223 Fulton St.
Berkeley, CA 94720
(415) 642-4151

Item: The CDC-7600 at LBL is going down.

This is fair warning to all of you who have access to the LBL computer on government contracts. The entire BKY system will be turned off on July 1, 1985. This includes the CDC 7600, CDC 6600, CDC 6400, the ATL, PSS, GSS, and RECC.

The new LBL computing configuration will consist of five VAX 8600's, which are being installed in increments beginning in March 1985. This will mean that you will have to learn a new editor as well as new procedures for running DOE-2. Also, make sure that any files you want saved get transferred. To do so, you will need an account on the VAX. Contact Fran Permar, (415) 486-6310 to open an account. For assistance on file and GSS tape transfers, call the Help Desk at the LBL Computer Center, (415) 486-5981.

We in the Building Energy Simulation Group are also in the process of changing our computing environment. For the past year, we have been running on a DEC-10. This month, we moved our development work, in fact all of our work including documentation, to an ELXSI 6400. The new machine will greatly enhance our computing speed and storage capacity; it also means that if you want an ELXSI version of DOE-2.1C, it is available now, along with the CDC and DEC-10.

THE DAYLIGHTING NETWORK

The idea was germinated over a year ago in the Windows and Daylighting Group at LBL. Today, the Daylighting Network of North America (DNNA) is in the process of selecting official regional centers, from a roster of Canadian and American colleges and universities, to serve as nodes in DNNA. The network is being developed to ensure adequate applied architectural research in the field of daylighting, to encourage technical information transfer to building professionals, and to create regional databases in the building sector.

Decentralized nodes, in the form of Regional Daylighting Centers, will make available localized centers of daylighting instruction, research, and expertise. Founders of

DNNA stress that although at present membership in the network is limited to colleges and universities, a primary goal of the organization is to "aid in communicating state-of-the-art daylighting information to the design community".

Each center will also undertake a specific, non-overlapping, activity in the network's effort to "strengthen the role of daylighting as a design issue in architecture". Among those planned are physical model testing, monitoring daylighting performance in existing buildings, conducting workshops for design professionals, maintaining a daylighting library, and conducting computer daylighting analysis. DOE-2.1B has already been implemented at a number of the founding universities. For more information on DNNA, contact:

Daylighting Network of North America
c/o Fuller Moore
Department of Architecture
Miami University
Oxford, Ohio 45056

MICROCOMPUTER UPDATE

It seems that every trade journal carries an advertisement for a new microcomputer-based energy analysis program. Many times the DOE-2 program is referenced as a source of the systems and plant algorithms, and in some cases, the ad implies that DOE-2 itself has been loaded on a micro. This state of affairs generates all sorts of questions for us to answer; perhaps we can clear up some of them here.

First, DOE-2.1C, the most recent version of the program, is written in FORTRAN and there are approximately 90,000 lines of code, including comments. This size program will not fit on any microcomputer in production. (See the August 1981 issue of this newsletter for a discussion of the obstacles to implementation of the program on a micro.) It will, however, fit on a number of mini-computers — VAX, Prime, Apollo, to name a few. We can refer you to the organizations that have accomplished these conversions.

Inevitably, the time will come when micros will be capable of handling DOE-2 in its complete form. Already, DOE-2 is claimed to have been reduced to a very basic (no frills) version that does run on a hard disc micro. Since we have not seen this program demonstrated, nor its documentation, we really don't know how basic it is, but it probably has some semblance to the earliest versions of DOE-1.

In most cases where DOE-2 is referenced, the authors have pulled from the DOE-2 Engineers Manual the systems and plant algorithms that matched their needs and married them to the ASHRAE TC-4.7 Modified Bin Method. In other cases, these same DOE-2 algorithms have been matched to hourly schemes where 12 typical days (one for each month) are used in lieu of the bin method.

Another completely different approach, one taken by the Energy Analysis Group here at LBL, has been to take a large data base of some 10,000 DOE-2 parametric runs for residential buildings. By using regression techniques, they were able to reduce the data base to fit on a microcomputer. (See the Summer 1984 issue, page 3, for a discussion of this project.)

Interactive preprocessors for DOE-2 are also available, and, of course, standard microcomputer editing programs can be used to prepare a DOE-2 input file without the help of the preprocessor. In either case, the input file can then be submitted as a batch run on a mainframe. This saves on connect time and telephone line charges in comparison to the costs of preparing the input on the mainframe itself.

In time we expect that micro programs called post-processors will be developed that accept the output of DOE-2 runs, and which make it possible to reformat the data into customized reports and graphics specified by the user. Another development in progress is the use of micros to do the work of comparing and checking for compliance the prescriptive requirements of the new ASHRAE Standard 90. Such programs would store the DOE-2-produced coefficients for different building types and weight the contribution of conduction, lighting, equipment, and solar components to energy use for heating and cooling. Not that these calculations can't be done manually, but the microcomputer can certainly expedite this work.

The picture for the future implies a very large place for microcomputers as a companion to DOE-2. We do not feel that DOE-2's present inability to run on a desk-top computer puts it in an adversarial position. On the contrary, we believe that most engineers will use all energy analysis tools with equal ease, and pick and choose the appropriate one that best matches their needs. The modified bin method, for example, can handle energy compliance and design comparisons in the conceptual stages of design, and on simple buildings cover the final stages of proving energy budget compliance. On innovative or complicated buildings, DOE-2, or some other mainframe program, will probably get called into play because its greater power and ability to handle complex interactions of building subsystems become an essential ingredient to a successful solution.

A HEAVY WORKOUT FOR DOE-2

In the course of developing the ASHRAE SP-41 committee's work on ASHRAE/IES Standard 90 Revision, DOE-2.1B received a substantial workout. Nearly 2000 parametric runs were made varying window-to-wall ratios, insulation levels, glazing types, shading coefficients, lighting power, climate, and daylighting schemes. In addition, another 1400 runs were prepared to test the effectiveness of the proposed standard in eight different climates for ten different building types.

This last year the ASHRAE SSPC90R Committee has been working to draft a final standard based on the work originally proposed by SP-41. Again, DOE-2.1B will be used to test the effectiveness of this standard.

What is even more important to DOE-2 users is that DOE-2 will probably be referenced in the new standard's Section 10: Energy Budget Compliance. The energy budgets for prototypical buildings developed from DOE-2 runs will eventually be made a part of the standard. A user may then check his/her proposed building for compliance by comparing these prototypical budgets against a DOE-2 run — or any other energy analysis program which produces comparable results. Using a comparable program will of course require checking the results against the prototype building budgets produced by DOE-2; ASHRAE will develop a standardized method to determine equivalence. Obviously, a person familiar with and comfortable in using DOE-2 will have less work to do than a person using another program.

Against this background, it is appropriate to comment on the future support of DOE-2. Rumors apparently abound that we would drop support of DOE-2 once development ends at the close of this year. We would like to put these rumors to rest, and state unequivocally that we have every intention of supporting DOE-2 as long as it remains a viable tool.

It is true that we are not in a position to support older versions of the code, and for that reason request users to upgrade to the latest version of the program. But once DOE-2.1D is completed next year, we will continue to upgrade the final program, fixing bugs and making other minor adjustments that may be needed. In the meantime, we will be working on the next generation program, which we hope will be received with the same enthusiasm as that shown for DOE-2.

THE HEAT EXCHANGER

This section is devoted to questions from users and responses from the Building Energy Simulation Group and its consultants. Your questions and comments are most welcome.

Question: How can I simulate a bypass system, i.e., a system which bypasses or short-circuits return air back into the supply air stream without passing it through the cooling coil?

Answer: For the designer not familiar with this requirement, it stems from the need to increase the supply air flow over that required to handle the space sensible gains. It is a technique that is most frequently used to maintain 30 to 60 air changes in clean rooms or in hospital surgeries. But the same approach can be used to double a standard system design flowrate of 0.5 to 1.0 CFM/sqft. The design flowrate of 0.5 CFM/sqft, which is too low for good circulation in the space, can easily result from modern lighting and glazing systems.

We intend to address this bypass system design requirement in DOE-2.1D. In the interim, we suggest that you increase the SUPPLY-KW and RETURN-KW values in proportion to the increase in supply air flow that is desired. Think of it as adding a recirculating fan in each conditioned space, accounting for the increase in fan energy but not the actual air flow.

The alternative of raising the MIN-SUPPLY-T, thus decreasing the dehumidified rise, has the disadvantage of inadequate moisture removal in the simulation, especially in humid climates. Notice too that if you simply double SUPPLY-CFM without changing the MIN-SUPPLY-T, you double the capacity of the cooling system, which results in the simulation of an inefficient refrigeration unit as well as inadequate moisture removal.

NOTICE

The first international Building Energy Simulation Conference (BESC) is being held in Seattle, Washington on August 21 and 22, 1985. The U.S. Department of Energy, Passive Solar Division, is sponsoring the conference, and it should be a very productive two days for all who attend.

BESC 1985 is expected to gather architects and engineers, building owners and managers, and building energy simulation researchers together to exchange information on this rapidly expanding field. Speakers come from all sectors of the building science community — industry, utilities, research, and government, and represent countries as diverse as Japan, Australia, France, and Canada. Inquiries should be directed to:

Pamela Garland, Conference Coordinator
721 N.W. 30th Street
Corvallis, Oregon 97330
(502) 754-9080

350/4-85 This work was supported by the Assistant Secretary for Conservation and Renewable Energy, Office of Buildings Energy Research and Development, Building Systems Division of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.