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PUB-439

Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720

DOE-2 USER NEWS

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

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Table of Contents

BULLETIN BOARD

Item: ASHRAE has recently announced the release of an expanded series of WYEC weather tapes. The new tapes, four in all, cover 51 cities in North America arranged in two different groupings: either the original 22 U.S. cities obtained from ASHRAE RP 239 (Tape #1), plus 29 additional U.S. and Canadian cities dispersed throughout North America obtained from ASHRAE RP 264 (Tape #2); or, geographically grouped, the 21 cities east of the Mississippi River (Tape #3), and 30 cities west of the Mississippi (Tape #4). The prepaid cost is $400 per tape. For more information, contact ASHRAE Publications Sales, 1791 Tullie Circle NE, Atlanta, GA 30329, (404) 636-8400.

Item: A three-day intensive course in the use of DOE-2 will again be offered this summer at the University of California at Berkeley. The instructors are James J. Hirsch and Fred Buhl, two of the principal authors of the program. The course will cover the BDL input language, present overviews of the simulation programs, and will include discussions of the new features introduced into the new DOE-2.1C version of the code, which will be released this Fall. The course, "Building Energy Performance Analysis Using the DOE-2 Computer Program", will be held on August 20 through August 22, 1984, and advanced enrollment is required. For more information, please refer to Continuing Education in Engineering, University Extension, University of California, 2223 Fulton St., Berkeley, CA 94720, (415) 642-4151

FROM HERE TO DOE-2.1D

The Building Energy Simulation Group is preparing to wind down its involvement with the DOE-2 program. The finalization of the program will leave it in as bug-free and utilizable form as we can make it. The last major developmental version of the program will be 2.1C, which should be released this winter. The final version of DOE-2 will appear sometime in the next two years when we issue DOE-2.1D. After that time, our efforts will be directed toward the creation of a new generation computer simulation program.

Why a new program? One, because the basic algorithms in the present program have been stretched to their limits. But even more importantly, because DOE-2 is inherently limited, as is every current whole-building program, by the sequential structure of its subprograms. Although there are iterations within subprograms, there are no feedback loops between them, preventing the transfer of information generated in a downstream subprogram back up through the loop. For example, in DOE-2, there is no feedback from SYSTEMS to LOADS, or from PLANT to SYSTEMS. A third obstacle in the current generation of programs is the hourly time-step. This is a severe limitation when trying to model equipment or control systems which have response times of minutes or even seconds.

Since in reality the response of virtually every building element produces thermal feedback on every other in a continuous flow of time, some amount of error is introduced by these artificial splits and time-steps. The needs of the current and future research community require the removal of these limitations, and that in turn requires a radical restructuring of the program. Our goal over the next five years is to develop, in coordination with an international team of government and private sector researchers, a combined envelope and system simulation program allowing variable time-steps, and with a new language processor, to allow fully dynamic building simulation.

We will continue to maintain DOE-2 (fix bugs, update documentation, publish the newsletter, etc.), but major developmental work will be reserved for the new program. The 2.1C version, which we have now nearly completed, will contain the following new capabilities:

(Continued on page 2)

PUB-439

- functional values in LOADS (the ability to replace DOE-2 code with user-supplied algorithms),
- a sunspace model,
- the powered induction unit (PIU) system,
- a refrigerated case work model,
- optimum fan start option,
- new plant equipment operating modes for cogeneration strategies,
- general utility rate structures, including time-of-day pricing, and
- frequency options for hourly reports.

The functional values capability, which will be extended to SYSTEMS in 2.1D, will be of especial significance given the finalization of the code. It will allow the user to have control over the code (within the confines, of course, of its present structure), to override our algorithms, and to simulate innovative designs not available in the present code. An article in the DOE-2 User News, Vol. 3, No. 4, November 1982, describes this feature in greater depth.

Work has also begun on a complete, and final, set of DOE-2 documentation, including a new format for the Reference Manual. It has long been felt that the mere bulk of the material presented in that volume was a discouragement to the new user. The 'recipe-book' style has also become somewhat of a liability since the introduction of recent features, with their input instructions scattered among many commands (e.g., daylighting), and even across programs (e.g., sunspaces). That, plus the lack of distinctions between essential input requirements and the more elective modelling techniques (in inputting building geometry, for instance) can lead to confusion and hunting and picking through command and keyword descriptions. We therefore plan to split the Reference Manual into two manuals: a basic one, in the present style, for most models and normal usage; and an advanced manual containing discussions of the more complex capabilities of the program. The advanced manual will treat each topic, such as Parametric Runs, or Curve Fits, as an integrated whole. It will assume a thorough understanding of BDL on the part of the reader.

The BDL Summary will remain intact, but will be structured to indicate the dividing-line between basic commands and keywords, and the higher-level input options. We have been expanding the reference lists in this volume, most recently a complete list of Summary and Verification Report code-words and titles; in the DOE-2.1C version, we will add the Materials Library. Any other suggestions for inclusion in this desk-top, quick-reference volume will gladly be considered.

A DOE-2.1C version of the Sample Run Book is being prepared for release this winter. The structure has been revamped, substantially reducing the size of the volume. The original sample runs have been updated, and will include descriptions and demonstrations of most of the refinements added to the program since DOE-2.1A. The instructional nature of the book will be considerably improved with the addition of models for daylighting (including functional values), sunspaces, the PIU system, optimum fan start, cogeneration, and varied utility rate structures.

And, finally, the Engineer's Manual will be brought up to date by the addition of chapters reflecting all new code since DOE-2.1A. Since this will be the last document in the series to be completed, two interim publications, Daylighting Calculation in DOE-2 (now available from LBL), and DOE-2 Functional Values Engineering Report (to be published), are expected to fill the major gaps until its release.

With these new reference tools and a stable, yet flexible program, we expect DOE-2 to be of good service to the energy efficient buildings community for a long time to come.

RECENT LBL PUBLICATIONS

Two recent publications stemming from energy conservation studies at Lawrence Berkeley Laboratory may be of interest to our readers. The first is a fact-laden technical document which discusses the methodology and assumptions underlying a set of voluntary guidelines entitled "Affordable Housing Through Energy Conservation". This work is the result of a three-year project conducted by the Energy Analysis Group at LBL to design simplified energy analysis tools capable of accurately estimating the energy savings associated with various energy conservation measures used in site-built single-family homes. The technical support document, Affordable Housing Through Energy Conservation: A Guide to Designing and Constructing Energy Efficient Homes: Technical Support Document, November 1983, (available in draft form from NTIS, #DE84000742) describes the development of a slide rule calculator which can to be used by home builders, buyers and others in the building industry to estimate the savings due to the addition of energy conservation measures to a basic residential design. With this new tool, one can recreate the results of numerous parametric DOE-2 runs for conventional houses without a substantial reduction of accuracy or detailed technical knowledge.

The slide rule is actually a simple graphic representation of a comprehensive data base of DOE-2.1A simulations incorporating a full range of energy conservation measures on five prototype residences in 45 different climates. The data base itself should provide the building community with a vast amount of technical information. Copies of the complete data base, on paper or tape, should be available in a few months. The final guide book, together with the slide rule, construction details, and economic worksheets, is due to be published by the end of the year. A micro-processor version of the slide rule is under development.

Another large DOE-2 data base figures in the second publication, Commercial Building Energy Performance Analysis Using Multiple Regression Procedures, which has been submitted for publication in ASHRAE Transactions. This data base was constructed from a series of DOE-2.1B simulations to study factors that influence the selection of fenestration — orientation, window/wall ratio, shading coefficient, lighting wattage, use of daylighting, and presence of overhangs. In addition, various levels of exterior wall conductances were investigated.

Using large simulation programs such as DOE-2 to test more than a few building parameters through parametric analysis can be very costly. The study successfully proves that multiple regression statistical methods can reduce the problem to a set of simple algebraic expressions. The predictions derived from this technique substantially reduce the number of computer runs needed to obtain accurate results, and, thus, provide a useful tool for analyzing energy changes when the data base includes a large variety of parameters of interest.

The results of this study are being considered for incorporation into the upgrading of ASHRAE/IES Standard 90, and work is in progress to expand the data base beyond its present focus on fenestration, to allow qualitative and quantitative predictions due to changes in construction, usage patterns for lighting, equipment, and occupants, and HVAC system types, and will be also extended to single-family residences.

This paper is currently available as an LBL Report, LBL-16645. The authors are Robert Sullivan and Shirley Nozaki of the Building Energy Simulation Group, and Richard Johnson and Stephen Selkowitz of the Windows and Daylighting Group.

* * * * *

A RIDDLE

What happens if you input

```
SET-DEFAULT FOR ROOF   TILT = 0  ..
```

followed by a normal LOADS input deck, allowing all of the routine keywords to default?

Answer: You get a fallen house of cards; all of the exterior walls will be facing the sky. Why? Because ROOF is a synonym for EXTERIOR-WALL in BDL, and setting the default for ROOF will override the built-in default of 90° on all the walls as well.

Conversely, one must always specify TILT when inputting a roof. ROOF alone means nothing to the program in terms of tilt, z dimension, orientation — or any other surface property for that matter; it will get the standard 90° wall tilt if allowed to default.

The same holds true for UNDERGROUND-FLOOR, which is synonymous with UNDERGROUND-WALL.

INDEX TO THE DOE-2 USER NEWS

A regular Summer feature of the newsletter is the cumulative subject/title index to all articles published herein.

Information Sheet and Order Form:

DOE-2 Building Energy Use Analysis Program

Version 2.1B

The following may be ordered from NTIS by telephone, (703) 487-4650 or FTS 737-4650, or by mail. There is a 15% discount on 20 or more copies of documentation.

_____ copies DOE-2.1B Program Tapes DE83048782 @ $1820. †

Machine Type:

☐ CDC ☐ DEC VAX ☐ IBM

Character Type:

☐ EBCDIC ☐ ASCII

(The tape will be 9-track, 1600 bpi, unless otherwise specified)

_____ sets Complete DOE-2.1B User Documentation PB84129253 @ $180.

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You may also order by individual title:

* * *

___ copies Vol. I, Part 1, BDL Summary (Version 2.1B) DE83012486 @ $11.50
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___ copies DOE-2 Supplement (Version 2.1B update to the Reference Manual) DE83011814 @ $14.50

* * *

_____ copies DOE-2 Engineers Manual, Version 2.1A, DE83004575 @ $34.50.

_____ subscriptions to the quarterly DOE-2 USER NEWS PB81912100
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† Includes one complete set of documentation.

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