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DOE-2: A COMPUTER PROGRAM FOR
BUILDING ENERGY SIMULATION

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* * * HANDS ON * * *

Bugged by 2.1C?? To date, 51 bugs in 2.1C have been fixed. If you would like to "trade-in" your old 2.1C tape for our bug-free version, please call Kathy Ellington (415-486-5711) for instructions.

Newsletter Distribution — Starting with the Spring 1988 issue, the USER NEWS will be distributed by the National Energy Software Center at Argonne, IL. The USER NEWS will continue to be written and printed by the Simulation Research Group, and questions or comments should still be directed to the group at LBL. Subscription cost of the USER NEWS is being negotiated and subscribers will be notified of any changes.

Documentation Correction — Please see the 2.1C Supplement, pages 1-12. On the first line at the top of the page, change

FNTYPE.NE.3.0
to
FNTYPE.NE.4.0

This is in Example 5 of Loads Functional Values.

With FNTYPE.NE.3.0, the window visible transmittance value will be changed *AFTER* the daylight illuminance calculation, so the previous-hour value of visible transmittance will be used in the daylighting calculation.

Directory of Services — The DOE-2 program, and its position as benchmark software in the A/E community, has generated a number of program-related software and services. A Directory of DOE-2 related software, services, and documentation is printed on the inside back page of this newsletter. All readers are urged to contact us with other sources.

A Dollar Here, A Dollar There — The National Technical Information Service has increased the prices of DOE-2 documentation for 1988. However, the increases are very small, in the \$1 to \$2 range. Please check the Directory on the inside back cover of this newsletter for new prices.

DOE-2 Course at U.C. Berkeley — It's not too early to get your name on the mailing list for the 1988 DOE-2 course, to be presented by the University of California's Engineering Extension Office. Write to Dick Tsina or Karen Anderson, U.C. Extension Office, 2223 Fulton St., Berkeley, CA 94720 and request information.

WINDOW — 2.0

A Computer Program for Calculating U-Values and Shading Coefficients of Windows

[WINDOW-2.0 was originally written by the Windows and Daylighting Group at LBL as an in-house analysis tool. Because of the interest in industry and the fenestration research community in developing a standard window thermal analysis program, the program has been updated, made more user-friendly, and released to the public. New features continue to enhance the program; for example, the treatment of frame effects is being improved, and a library of standard optical properties for various glazing materials is being added.]

The WINDOW-2.0 program is available on a 5-1/2" floppy disk for \$25.00 (including User and Reference Guide) from M. Dodd, Michael Gabel Associates, 1818 Harmon Street, Berkeley, CA 94703. Phone (415) 428-0803.]

DESCRIPTION

With the increased use of low-emissivity coatings and the growing interest in gas filling, the number of window variations is rapidly expanding. The primary source of independent data on heat transfer through windows is the ASHRAE Handbook of Fundamentals, which is revised every four years. To obtain data on new products, or those slightly different than those in the ASHRAE Handbook, most manufacturers resort to developing their own proprietary computational models. While most of these models yield similar results, differing assumptions presented in various product literature, along with the lack of absolute consistency with ASHRAE or any other reference source, lead to confusion.

WINDOW-2.0 is a one-dimensional window heat transfer analysis program that is intended to provide a self-consistent standard for calculating heat transfer through windows. The program calculates U-values, shading coefficients, solar transmittance, heat fluxes through windows, and window layer glazing temperatures as a function of the environmental conditions (outside temperature, incident solar radiation, etc.) and window design parameters that primarily influence heat transfer.

Window U-values and shading coefficients calculated by WINDOW-2.0 can be input into DOE-2, thus allowing the hour-by-hour and annual energy impacts of advanced glazing technologies to be analyzed. The calculational procedure used in WINDOW-2.0 is consistent with standard ASHRAE calculation methodology; however, it offers the user many options in analyzing state-of-the art window systems under a full range of environmental conditions. WINDOW-2.0 can be run in either SI or English units, and runs interactively on an IBM-PC (with DOS 2.1).

The program requires as input the physical dimensions of the window, materials properties such as surface emissivities and gas thermal conductivities,

and environmental parameters. First, WINDOW-2.0 guesses a linear temperature distribution through the window. From these temperatures, the heat transfer coefficients are evaluated among the elements of the window. ASHRAE defines a hand calculation for iteratively refining the temperature profile, whereas WINDOW-2.0 does this automatically for any number of layers. The principle, however, is the same and the results are similar except for time spent. WINDOW-2.0 has added other refinements such as infrared-transparent plastics, gas-fills, and most important, the flexibility to add other features. The calculation procedure is described in more detail in *Calculating Heat Transfer Through Windows*, M. Rubin, **Energy Research**, Vol. 6, 341-349 (1982).

UPDATED PROGRAM

WINDOW-3.0, scheduled for release during the summer of 1988, will be a more user-friendly version of 2.0. WINDOW-3.0 will include technical improvements such as the ability to analyze tilted windows, glass in atria, a two-dimensional edge effect, and glazing material resistance. WINDOW-3.0 also calculates the overall visible transmittance of windows (in addition to the solar transmittance). Those who order a copy of WINDOW-2.0 will automatically receive an update to 3.0.

RELATED PUBLICATIONS

- (1) Arasteh, D., J. Hartmann, M. Rubin, *Experimental Verification of a Model of Heat Transfer Through Windows*, Windows and Daylighting Group, Report No. LBL-21576, Lawrence Berkeley Laboratory, Berkeley, CA 94720 (May 1986)

[The following paper discusses the effects of window and environmental parameters on U-values and SC]

- (2) Arasteh, D., S. Selkowitz, J. Hartmann, *Detailed Thermal Performance Data on Conventional and Highly Insulating Window Systems*, Proceedings of the ASHRAE/DOE/BTECC Thermal Performance of the Exterior Envelopes of Buildings Conference (December 1985).

[The next three papers discuss the effects of U-values and shading coefficients on building energy consumption and peak demand]

- (3) Choi, S., R. Johnson, S. Selkowitz, *The Impact of Daylighting on Peak Electrical Loads*, **Energy and Buildings**, Vol. 6 (1984) pp. 387-399.
- (4) Johnson, R., et al., *Glazing Energy Performance and Design Optimization*, **Energy and Buildings**, Vol. 6 (1984) pp. 305-317.
- (5) Sullivan, R., and S. Selkowitz, *Energy Performance Analysis of Fenestration in a Single Family Residence* in **ASHRAE Transactions**, Vol. 91, Part 2 (1985)

NEW DOE-2 BUGS, INTERIM SOLUTIONS, AND FIXES

Following are new bugs discovered in the 2.1C version of the program; users are urged to document suspected bugs, and report them to us. Each bug is described and a temporary (no code change) solution is listed along with the date the permanent correction was moved to our 2.1C release files. If you received a tape sent by us after the date given in the bug description, then the bug fix is already on your tape in one of the "mod" files. In any case, before you fix a bug, make sure it has not already been corrected on your DOE-2.1C tape. All users who received DOE-2.1C tapes prior to April 4, 1986, should read the descriptions of bugs D-29 and D-30 (see back issues of the USER NEWS), and fix these bugs or avoid them.

The bug fixes listed below are in the form of UPDATE modification directives. Corrections are independent of each other (they do not interact); therefore, you can fix only those bugs you consider important. All the bugs for one program element are together; i.e., all the corrections to BDL are under the heading "FILE BDL.BUG". Lines beginning with */ are UPDATE comment lines.

Questions or comments should be directed (in writing) to Fred Buhl, Simulation Research Group, 90-3147, Lawrence Berkeley Laboratory, Berkeley, CA 94720.

Bug D-48

In a PIU system, whenever exhaust-cfm was greater than the supply-cfm in a zone, there would be a 0/0 error in DKTEMP in SYSTEMS.

Interim solution: Make sure that exhaust-cfm is less than supply-cfm for every zone for PIU systems.

Date moved to the release file: February 4, 1988 — Fix is on file: sys.bug

```
*/
*/ THIS FIXES BUG D-48
*/
*/ IN THE PIU, WHEN EXHAUST AIR EXCEEDED SUPPLY
*/ AIR IN A ZONE (NO RETURN AIR), THERE WERE
*/ SEVERAL STATEMENTS IN DKTEMP AND PIU WHERE
*/ THERE COULD BE A DIVIDE BY ZERO ERROR.
*/
*D DKTEMP.133
  IF (<IND-AIRZ-ZD> .NE. -100) <RCFM> =
  1 RCFMI * <RCFM> / AMAX1 (RCFMX, 1.E-6)
*D DKTEMP.137
  1 ZMULT * <RCFM> / AMAX1 (<RCFM>, 1.E-6)
*D PIU.466
  1 RCFMI * <RCFM> / AMAX1 (RCFMX, 1.E-6)
*D PIU.469
  1 *ZMULT * <RCFM> / AMAX1 (<RCFM>, 1.E-6)
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6
```

Bug D-49

When the SYSTEMS input contained both PIU and non-PIU systems, the output reports would abruptly cease after the SV-A reports were written. This was due to SYSTEMS writing extraneous SV-B (the PIU verification report) report records for the non-PIU systems.

Interim solution: none; you get SV-B whether you want it or not.

Date moved to release file: February 5, 1988 — Fix is on file: sys.bug

```
*/
*/ THIS FIXES BUG D-49
*/
*/ WHENEVER A SYSTEMS INPUT CONTAINS BOTH PIU AND
*/ NON-PIU SYSTEMS, EXTRANEIOUS RECORDS FOR REPORT
*/ SV-B WERE WRITTEN TO THE REPORT FILE FOR THE
*/ NON-PIU SYSTEMS, RESULTING IN AN ABORT BY THE
*/ REPORT GENERATOR PROGRAM AFTER ALL THE SV-A
*/ REPORTS WERE PRINTED.
*/
*I SVB.18
      NSP = IS + (NS-1)*NSS
      IF (<SYSTEM-TYPE> .NE. 23) GO TO 100
*D SVB.20
*D SVB.23
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6
```

Bug D-50

A user (who shall remain nameless) used the set-default command in the LOADS input to turn all his spaces into plenums (ZONE-TYPE=PLENUM). This causes the building net area to be zero, since plenums aren't added into the building floor area. This results in strange building level LOADS reports (mostly zero), odd SYSTEMS results, and a divide by zero abort in PLANT when creating the BEPS report. An error message has been added to LOADS to avoid this problem.

Interim solution: Don't do it.

Date moved to the release file: February 5, 1988 — Fix is on file: lds.bug, sim.bug

```
*/
*/ THIS FIXES BUG D-50
*/
*/ WHEN THE USER MANAGES TO MAKE ALL HIS SPACES IN
*/ LOADS TO BE ZONE-TYPE=PLENUM, THE BUILDING NET
*/ AREA IS ZERO. THIS RESULTS IN STRANGE OUTPUT
*/ AT THE BUILDING LEVEL FROM LOADS (MOSTLY ZEROES),
*/ DOESN'T DO MUCH FOR SYSTEMS, AND EVENTUALLY
*/ RESULTS IN A DIVIDE BY ZERO IN PLANT, WHILE
*/ WRITING OUT THE BEPS REPORT RECORDS. THERE IS
*/ ALSO A MOD TO SIM, TO INSERT THE ERROR MESSAGE.
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6
```

```

*/
*/
*/
*I LOADS.286
    IF (IERRF .EQ. 3) CALL ABT
*I READSF.674
    IF (BNAREA .LE. 0.) THEN
        CALL MSGSIM(4,N,N,N,N)
        IERRF = 3
    END IF
*/
*/ THIS IS PART OF THE FIX FOR BUG D-50.
*/ SEE LDS.MOD FOR AN EXPLANATION
*/
*D MSGSIM.45
    104 WRITE (IOUTPT,1004) ERRPX
    1004 FORMAT(3A4,27H BUILDING NET AREA IS ZERO,
        1 34H CHECK ZONE-TYPE, SPACE MULTIPLIER,
        2 22H AND FLOOR-MULTIPLIER.)
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6

```

Bug D-51

PLANT aborts with a divide by zero error when a gas domestic hot water heater has been defined in the PLANT input, but there is no domestic hot water load (due to the user forgetting to input the BUILDING-RESOURCE command in the LOADS input).

Interim solution: don't forget the BUILDING-RESOURCE input.

Date moved to the release file: February 5, 1988 — Fix is in file: plt.bug

```

*/
*/ THIS FIXES BUG D-51
*/
*/ WHEN THE DOMESTIC HOT WATER HEATER IS
*/ AUTO SIZED TO ZERO, DUE TO NO DOMESTIC
*/ HOT WATER USE, THERE IS A DIVIDE BY ZERO
*/ WHEN CALCULATING THE PART LOAD RATIO.
*/
*I GASDHW.34
    IF (OPCAP(6) .LE. 0.) RETURN
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6

```