Building Energy Simulation

User News

For Users of DOE-2, SPARK, BLAST and their Derivatives

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June 28-July 2, 1997 in Boston, Mass
January 17-21, 1998 in San Francisco, California
June 18-25, 1998 in Toronto, Ontario

What's Inside?

The *User News* is published by the Simulation Research Group at LBNL with cooperation from the BLAST Support Office at the University of Illinois. Direct comments or submissions to Kathy Ellington, Editor, MS: 90-3147, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, or email kathy@gundog.lbl.gov or send us a fax at (510) 486-4089. Direct BLAST-related inquiries to the BLAST Support Office, phone (217) 333-3977, send email to support@blast.bso.uiuc.edu ☺☺☺ 01/97 2000

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Integrating the BLAST Fan System and Central Plants Using a Simple Model of the Fluid Loops

by

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1. Motivation

In the Summer 1996 issue of *User News* (Vol. 17, No. 2) the integration of the BLAST zone and system simulations was described along with its use in the IBLAST (Integrated BLAST) program. In this follow-up article the development of a method for simulating the interactions between the fan systems and central plants is described. As was the case for the zone and system simulations, feedback between the system and plant is important for determining the effects of plant sizing on system operation and building comfort. An example to illustrate the importance of this feedback is a plant with insufficient chiller capacity to meet the peak system cooling load. In this case, the system is unable to provide sufficient cold air to the conditioned spaces and, consequently, thermal comfort requirements may not be met. The goal of integrating the system and plant simulations is to determine the zone conditions which will result based on the actual plant size.

2. Development of System/Plant Integration Methods

In BLAST, the central plant models are based on performance curves that are generated from manufacturer data. In the case of boilers and chillers, the performance curves depend on the entering and leaving water conditions. However, in BLAST the water loop to the heating and cooling coils is not simulated and nominal conditions are used. BLAST allows up to three types of chillers, boilers, generators, and condensers on each building and there may be up to six sizes of each equipment type. Optimization is simplified by assuming that all equipment of the same type has the same part load performance characteristics. Different types of plant equipment can interact with each other because BLAST keeps track of the waste heat generated by the equipment. This is monitored by amount and grade and can be used to meet loads that require an equivalent or lower grade of heat input.

In BLAST, the processes and equipment that allow feedback between the zones, fan systems and central plants are not modeled. In order to integrate the air handling system simulation with the zones simulation in IBLAST, the system air loop and its interactions with the zones due to controls had to be modeled. A similar situation was encountered when integrating the central plants simulation in IBLAST. The central plant interacts with the systems via a fluid loop between the plant components and the system heating and cooling coils. However, in BLAST, neither the coil nor the loop models were sufficiently detailed to be useful in the integrated simulation. Since the BLAST coil models were not suitable, they were replaced by more detailed and rigorous models based on the algorithms found in the MODSIM (Clark, 1985) program. These models obtain the coil outlet conditions by solving the heat balance between the air and water streams given the flow entering conditions and the coil geometry. Thus, the plant outlet conditions, coil inlet

conditions, coil outlet conditions, and plant inlet conditions could all be related using energy and mass balances on the appropriate fluid streams.

2.1 Plant Models

The detailed heating and cooling coil models provided IBLAST with a method to link the system air loop to the chilled and hot water loops served by the central plant. The next step in the integration process was to add the plant components to the simulation since these determine the conditions in the loop. These components are chillers, which supply chilled water to the cooling coils, and boilers, which supply hot water or steam to the heating coils.

2.1.1 Chiller Models

A typical chilled water plant may have several chillers operating in parallel. This arrangement allows the chillers to be sequenced to operate near the optimal part load ratio for a longer period of time than if a single large chiller was used. The operating characteristics of each chiller are simulated using equipment performance parameters obtained from manufacturer's data. All the models use the same basic set of four equations to determine chiller power consumption. The distinct operating characteristics of each chiller type are obtained from these equations by adjusting four sets of performance parameters. The first set of performance parameters (ADJT) is used to calculate the chiller equivalent temperature difference, *DT*:

$$\Delta T = \left[\frac{\left(T_{cond} - ADJT(1)\right)}{ADJT(2)}\right] - \left[T_{chiller,\,out} - ADJT(3)\right] \tag{1}$$

In BLAST, the values of T_{cond} , the condenser water leaving temperature, and $T_{chiller,\,out}$, the leaving chilled water temperature, are specified by the user and do not change during the simulation. In IBLAST, the leaving chilled water temperature must be the same as the coil entering water temperature. Next, the ratio of chiller available to nominal capacity, *ANCR,* is determined using the calculated *DT* and a second set of performance parameters, *RCAV*:

$$ANCR = \left[RCAV(1)\right] + \left[RCAV(2)\right]\Delta T + \left[RCAV(3)\right](\Delta T)^2 \tag{2}$$

The *ADJE* performance parameter set is used to compute the full load power ratio, *FLPR*. The full load power ratio is given by the power consumption at the available capacity divided by the available chiller capacity. The ratio of *FLPR* to the nominal full load power ratio is then given by:

$$\frac{FLPR}{NFLPR} = \left[ADJE(1)\right] + \left[ADJE(2)\right](ANCR) + \left[ADJE(3)\right](ANCR)^2 \tag{3}$$

Finally, the fraction of full load power, *FFL,* is the ratio of chiller actual to full load power consumption calculated from the *RPWR* parameter set and the chiller part load ratio, *PLR*:

$$FFL = \left[RPWR(1)\right] + \left[RPWR(2)\right](PLR) + \left[RPWR(3)\right](PLR)^2 \tag{4}$$

where *PLR* is the cooling load divided by the actual capacity of the chiller. The calculation of the chiller actual power consumption varies according to the type of chiller being simulated. Additional details regarding this calculation and the determination of the four performance parameter sets from manufacturer data is detailed in the BLAST User Reference. Once the amount of cooling provided by the chiller to the coil water supply has been calculated the result must be compared with the enthalpy change of the water across the chiller. That is, the result must satisfy:

$$OCAP + \dot{m}_{cw} C_{p,w} (T_{chiller,out} - T_{chiller,in}) = 0 \tag{5}$$

where *OCAP* is the actual cooling provided by the chiller. This equation must be solved simultaneously with the coil performance equations to obtain chiller entering and leaving water temperatures that match the cooling coil entering and leaving water temperatures.

2.1.2 Boiler Models

Two types of boiler models are available in the IBLAST simulation: a fossil fuel fired boiler and an electric boiler. As with the chiller models the boiler simulations are based on curve fits to manufacturer performance data that can be tailored to match specific equipment. In the case of the fuel boiler the performance is specified by the *RFUELB* data set that is used to compute the ratio of theoretical fuel consumption to actual fuel consumption. The theoretical fuel consumption is computed from:

$$\dot{Q}_{fuel,theoretical} = \frac{\dot{Q}_{load}}{\left[0.87 - 1.25\left(\frac{STRATB}{HFUELB}\left[T_{leave} - T_{air}\right]C_{p,exhaust}\right)\right]} \tag{6}$$

where *STRATB* is the fuel air ratio in lb/lb, *HFUELB* is the heating value of fuel in Btu/lb, T_{leave} is the boiler stack leaving temperature in °F, T_{air} is the ambient air temperature in °F, and $C_{p,exhaust}$ is the specific heat of the exhaust gas, which is assumed to be a constant value of 0.24 Btu/lb-°F. The theoretical fuel consumption is then used to compute the actual fuel consumption of the boiler from:

$$\dot{Q}_{fuel,actual} = \frac{\dot{Q}_{fuel,theoretical}}{\left[RFUELB(1) + \left\{RFUELB(2)\right\}PLR + \left\{RFUELB(3)\right\}(PLR)^2\right]} \tag{7}$$

With this model the performance of the boiler is independent of the entering and leaving water temperatures so it is only necessary to ensure that:

$$\dot{Q}_{load} + \dot{m}_{hw}C_{p,w}(T_{boiler,in} - T_{boiler,out}) = 0 \tag{8}$$

This equation must be satisfied in conjunction with the heating coil performance equations. The electric boiler is somewhat simpler to model and details of the parameters required to simulate such a boiler can be found in the BLAST User Reference.

2.2 System-Plant Energy Balance

In order to ensure consistency between the plant and system inputs and outputs, the following conservation equations are used to enforce mass continuity and conservation of energy around the plant fluid loops.

$$\sum_{\substack{cooling\\coils}} \dot{m}_{w,in} = \sum_{\substack{cooling\\coils}} \dot{m}_{w,out} = \dot{m}_{chiller,in} = \dot{m}_{chiller,out} \tag{9}$$

$$T_{cooling\ \ coil,in} = T_{chiller,out} \tag{10}$$

$$\sum_{i=1}^{\substack{\#cooling\\coils}} \dot{m}_{i,w,out}T_{i,w,out} = \dot{m}_{chiller,in}T_{chiller,in} \tag{11}$$

Coil air inlet conditions are relatively easy to specify since they are dependent on the ambient outside air and zone return air conditions. The water side inlet conditions are a function of the capacity of the chillers or boilers and their ability to provide a certain flow rate of water at a specified temperature. However, it should be clear these equations do not represent a closed system since the coil outlet conditions are

determined by the coil performance and control strategy, and the coil inlet conditions are determined by the operation of the central plant components. These equations merely represent the link between the coil and plant simulations.

2.2.1 Quasi-Steady State Water Loop Properties

Quasi-steady state conditions are assumed in the water loop between the plant and the coils because the thermal capacitance of the water loop is typically small compared to the cooling or heating capacity of the plant. This is possible because the corresponding time constant is short in comparison to the time step used for the simulation. However, for systems such as the water loop heat pump or for thermal storage systems that are close to exhausting their capacity (e.g., an ice storage tank where all the ice is melted and only sensible cooling capacity remains), this would not be such a good approximation because then the supply water temperature could change appreciably in a time step. Fortunately, the water loop heat pump model can be implemented as a combined system and plant model, eliminating the need to iterate between the system and plant. In the case of the ice storage tank whose latent capacity is expended, any errors introduced are likely to be small since the tank sensible cooling capacity, when all the ice is melted, is small compared to the capacity of the fully charged tank.

2.2.2 System and Plant Controls

Controls are the devices used by the system and plant to regulate the quantity and temperature of air flowing out of the coils so that the correct conditioning is provided to the building zones. They are also required by the simulation so that the system of equations describing the system and plant operating characteristics is closed, allowing a unique solution to be found. This can be expressed mathematically in terms of the steady state zone energy balance as follows:

$$\dot{Q}_{load} + \dot{m}_{air,in} C_{p,air} \left(T_{supply\ air} - T_{zone} \right) = 0 \qquad (12)$$

where $\dot{Q}_{load}$ is the rate of energy transfer to the zone due to external and internal loads: radiation, conduction through the walls, infiltration, people, electrical equipment, etc. Since it is impossible to control $\dot{Q}_{load}$ in any practical way, the building air conditioning system must adjust both $T_{supply\ air}$ and $\dot{m}_{air,in}$ so that Equation 12 is satisfied and T_{zone} is maintained within a range consistent with the comfort requirements of the building's occupants.

Implementation of controls in IBLAST was accomplished using the controlled and uncontrolled forms of the coil model previously mentioned. In the controlled coil, the leaving air temperature is specified along with the air inlet conditions and the inlet water temperature. The simulation calculates the required water flow rate and the outlet conditions. For the uncontrolled coil, the temperature of the air leaving the coil is determined by the system air flow rate and the plant operating capacity. In this strategy, the system air flow rate is regulated to maintain the zone energy balance. Feedback between the system and plant changes the plant operating conditions so that the supply water temperatures and flow rates may also vary as the load changes. Thus, the supply air temperature is whatever value results from the current combination of air flow rate, plant operating status, and the heat and mass transfer processes occurring in the coil itself.

3. Implementation of Integration Methods

Simultaneous solution of the system and plant operating parameters requires that the temperature of the water entering the coils must be the same as the temperature leaving the chillers or boilers. In addition, the temperature of the return water from the coils must be equal to the chiller or boiler entering water temperature. In practice, as long as the plant is not out of capacity, the leaving water temperature from

chillers and boilers is essentially constant and equal to the design value. No iteration is required to match system and plant boundary conditions. However, if either the chiller or boiler plant is overloaded, then the temperature of the water leaving the plant is not equal to the design value and the maximum output of the plant could change as a result of the off-design conditions. Therefore an iterative scheme, using the secant method to predict successive updates to the plant leaving water conditions, was employed to solve for the water loop conditions with the plant operating at its maximum capacity.

The convergence criteria for the secant method are: the change in enthalpy of the fluid passing through all the systems served by the plant must be equal to the heating or cooling provided by the plant, the coil entering temperatures must equal the plant leaving temperature, and the system return temperature must equal the plant entering temperature. The secant method computes the change in the system coil load as a function of a finite deviation in the system entering temperature. The system entering temperature, at which the convergence criteria are satisfied, can then be extrapolated from this derivative approximation to the slope of the coil load curve as a function of supply temperature. The updated temperatures and coil loads are fed back into the plant simulation and the process repeated until the change in the plant leaving temperature becomes small.

This concludes the discussion of the methods used to integrate the BLAST fan system and central plant simulations in the IBLAST program. Together with the article published in the Summer 1996 *User News*, this article completes a broad overview of the modeling techniques used in IBLAST and which will subsequently be employed in the next-generation EnergyBase program (*User News*, Vol. 17, No. 1, p. 32-35, Vol.17, No. 3, p. 28). The reader is directed to the list of references for more detailed information.

4. References

BLAST Technical Reference, BLAST Support Office, University of Illinois at Urbana-Champaign, 1993.

BLAST Users Manual, BLAST Support Office, University of Illinois at Urbana-Champaign, 1993.

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Elmahdy, A.H., and Mitalas, G.P., "A Simple Model for Cooling and Dehumidifying Coils for Use in Calculating Energy Requirements for Buildings," ASHRAE Transactions, 1977, Vol. 83, Part 2, pp. 103-117.

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Taylor, R. D., Development of an Integrated Building Energy Simulation with Optimal Central Plant Control, Ph.D. Thesis, University of Illinois, May 1996.

Taylor, R. D., C.O. Pedersen, and L. Lawrie, "Simulation of Thermal Storage Systems in an Integrated Building Simulation Program," CISS: First Joint Conference of International Simulation Societies Proceedings, Zurich, Switzerland, August 22-25, 1994, pp. 744-748.

A directory of *Building Energy Tools* is now available from the U.S. Department of Energy on the World-Wide Web. The directory includes over 50 tools– from research grade software to commercial products with thousands of users. The common thread for all the tools is that they provide building-related information for improving energy efficiency or incorporating renewable energy concepts. Many of the tools in the first version, at some point in their life-cycle, were sponsored by DOE

The directory is already available on the world wide web at

http://www.eren.doe.gov/buildings/toolsdir.htm

where it will be kept updated and expanded. In the future, we will also provide information about the Department of Energy's energy tools research including DOE-2, BLAST, EnergyBase (DOE-2/BLAST merger), SPARK, Building Design Advisor, Softdesk Energy, Energy-10, and the International Alliance for Interoperability.

New tools included in the latest update are:

ComCheck-EZ	IWRAPS	REEP
Discount	LCCID	RESEM
EMISS	Quick BLCC	Watergy
ERATES	QuikFan	Wincomf
HBLC	QuikPlan	

If you know of other tools that should be included in the web directory, please let us know.

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U. S. Department of Energy

VisualDOE 2.5

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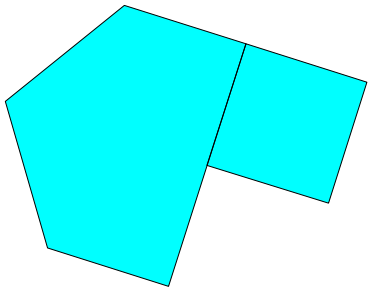
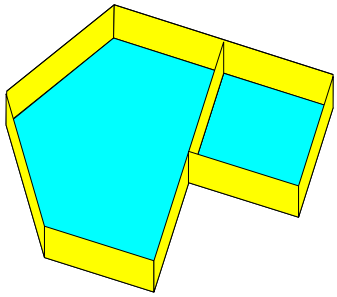
Eley Associates
San Francisco, CA

VisualDOE 2.0 was released in February 1996 (*User News*, Vol. 16, No. 4) and represented a significant upgrade to VisualDOE 1.0 (see *User News*, Vol. 15, No. 2). VisualDOE 2.0 is being used world wide by private architects and engineers, utilities, national laboratories, universities and others. Users have found how easy it can be to harness the power of DOE-2.1E through a true graphic interface that is much more than just a BDL editor. With its ease of use, VisualDOE can be used during all phases of building design. The VisualDOE developers have continued to add new features, many of which have been added with periodic updates. The latest set of enhancements, however, are significant enough for Eley Associates to issue a new release called VisualDOE 2.5. By most standards, the new program should be called 3.0, but since it will be provided to existing customers at no cost, the designation 2.5 is used.

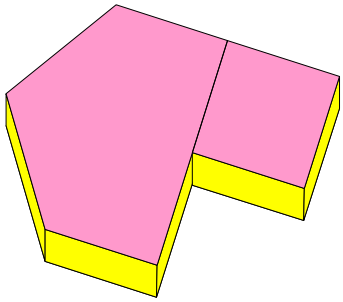
Figure 1 - The Concept of VisualDOE Blocks



A block consists of two or more thermal zones represented by adjoining polygons.



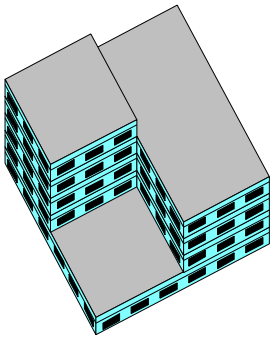
The polygon sides are extruded vertically to a distance equal to the floor-to-ceiling height. This process creates exterior walls or facades and interior walls separating zones.



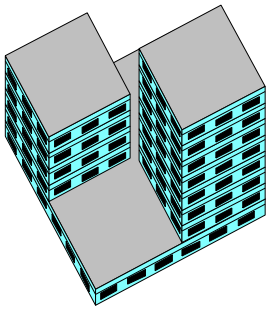
A roof surface is placed over each of the thermal zones.

For simplicity, these models show a block with no plenum; when blocks have plenums, more zones are created. Each zone has its own plenum if it is served by a separate HVAC system. Zones served by the same HVAC system share plenums.

Figure 2 - Arranging Blocks

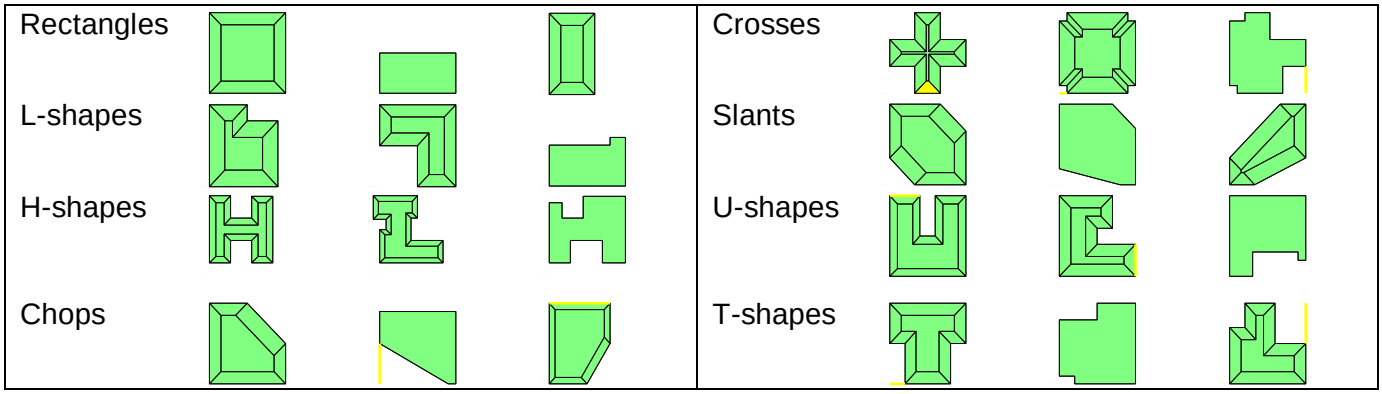


This model has three blocks: a square rectangle is at level 1, an L-shape with three floors is at level 2, and a small, square second rectangle is at level 3. VisualDOE creates three primary roof surfaces which may be subdivided into individual zones.



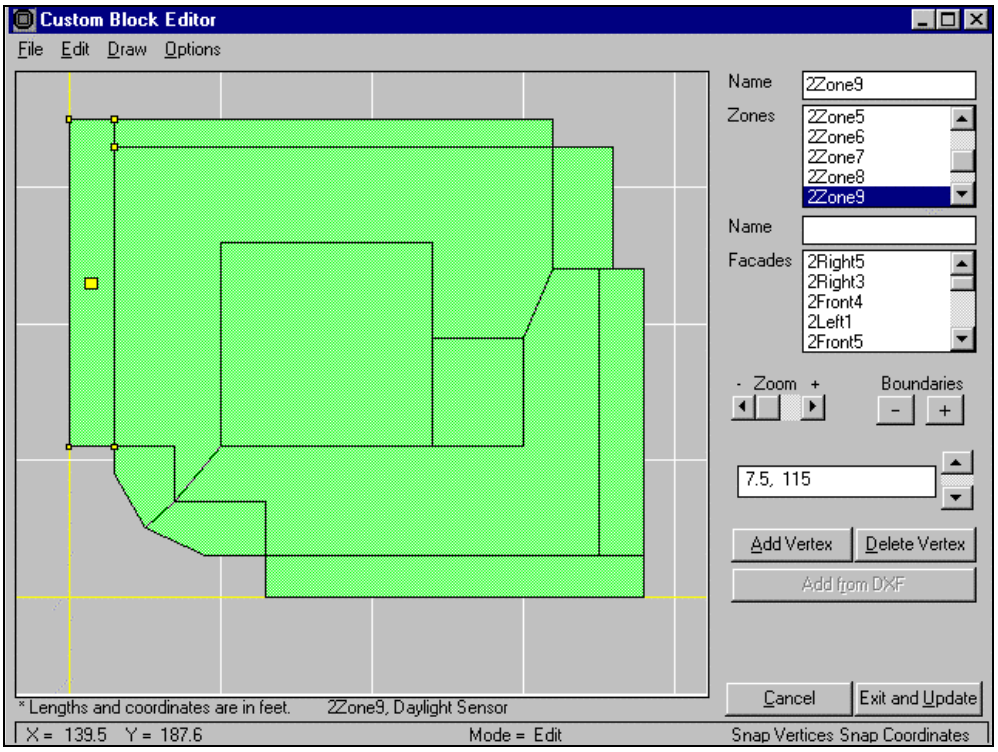
This model also has three blocks. A square rectangle is on level 1. Two additional rectangular blocks are located at level 2; one has seven floors and one has four floors. The model has three main roof surfaces.

Figure 3 - Standard VisualDOE Blocks - Examples



Custom Blocks

Figure 4 - The Custom Block Editor



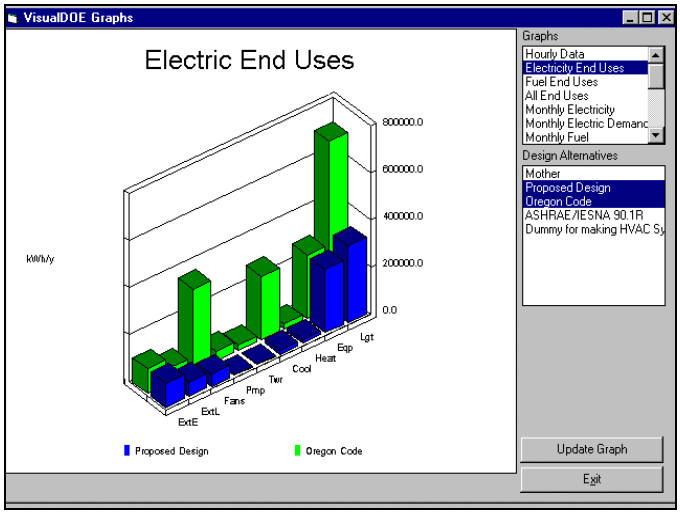
The most significant enhancement of VisualDOE 2.5 is the ability to create custom blocks by either *drawing* an outline of each zone or by *importing data from a CADD file*. In VisualDOE, the term "block" refers to a contiguous group of thermal zones located on the same level and with certain other common properties such as floor-to-floor height, number of stories, etc. (Fig. 1) The concept of blocks reduces the drudgery of creating individual zones, surfaces, and openings. Blocks can be on the same level or stacked on top of each other (Fig. 2). As blocks are stacked, VisualDOE automatically creates roof and floor surfaces. VisualDOE uses standard block shapes, such as rectangles, L-shapes and U-shapes (Fig. 3 shows some possibilities). While most common building floor plans can be created using standard block shapes, the Custom Block Editor allows you to create more complex floor plans in just about any configuration. Figure 4 shows a custom block of zones consisting of seven perimeter and four interior zones. This example has 16 facades (polygon sides that do not adjoin other polygons) and each facade can have its own properties like wall construction, window configurations, etc. Custom blocks can be created with a mouse to draw closed polygons (each representing a thermal zone), or by using a CADD program to draw the closed polygons. CADD files can be opened within VisualDOE and you can read the geometric data, thus enabling you to use base plans already created in CADD to create the zone outlines. For complex buildings, this can save considerable time. When using VisualDOE to create custom blocks, drawing features such as snap-to-grid, snap-to-vertex, and snap-to-line help create accurate models.

Graphing Results

You can now graph your simulation results.

Graphs can be customized to your taste and copied to the Windows clipboard for pasting into reports or other applications. A special graphing form is accessed by choosing File|Graphs from either the Graphic Editor or the Plant-Only Runs program modules. The VisualDOE Graphs form has controls on the right side where you choose a graph type, the design alternatives that you want to compare, variables to plot, and other information. Figures 5, 6, and 7 show examples of the many types of graphs that can be generated.

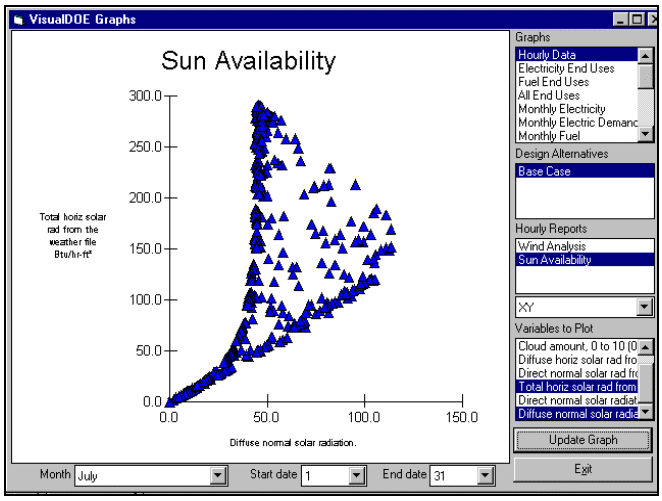
Figure 5 - Graphing Annual Results



Open-to-Below

Additional properties are available for thermal zones, including added infiltration control and a special property called *open-to-below*. When zones, located on levels higher than the first, are designated as open-to-below, VisualDOE looks to see which zones are directly beneath the open-to-below zone. These appear in a list box where you select one. This feature can be used to model multistory spaces such as atria or high bay lofts.

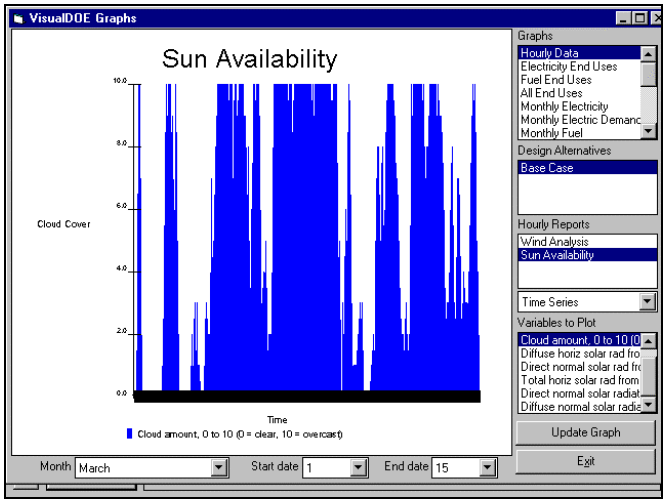
Figure 6 - Graphing Hourly Results



Exterior Shades

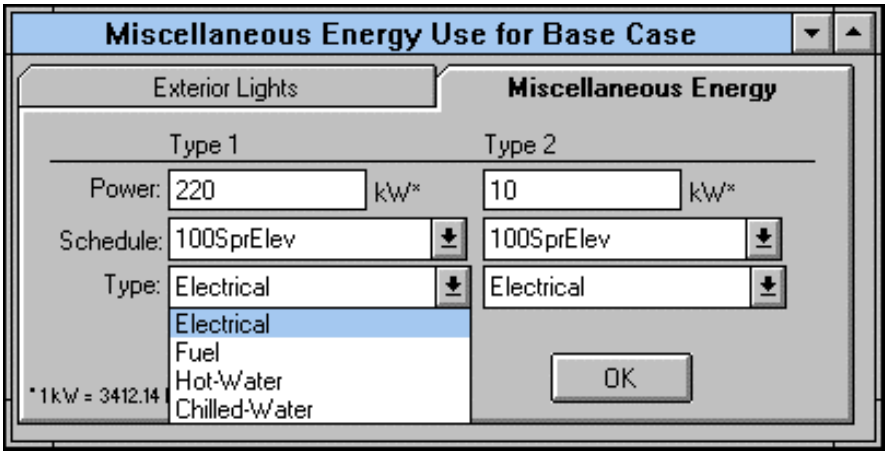
Solar gains are often quite significant loads, and solar loads are affected to a great extent by shading from adjacent buildings, trees and/or other obstacles. VisualDOE 2.5 allows you to enter any number of exterior shades. The graphic interface displays a footprint of your model and shows the size and position of shades as they are entered. Exterior shades are also displayed by the 3D Viewer (see Fig. 9). Each exterior shade has any number of properties, including the coordinates (X, Y, and Z), height, width, azimuth, tilt, visible reflectance (important for daylighting calculations), and ground reflectance. You can create a fraction schedule with the Schedule Maker and use this schedule to modify the transmission of the shade. This feature allows you to model deciduous trees or other shades with time-variable transmission.

Figure 7 - Graphing Hourly Results



Miscellaneous Energy Use

Figure 8 - Miscellaneous Energy Editing Form

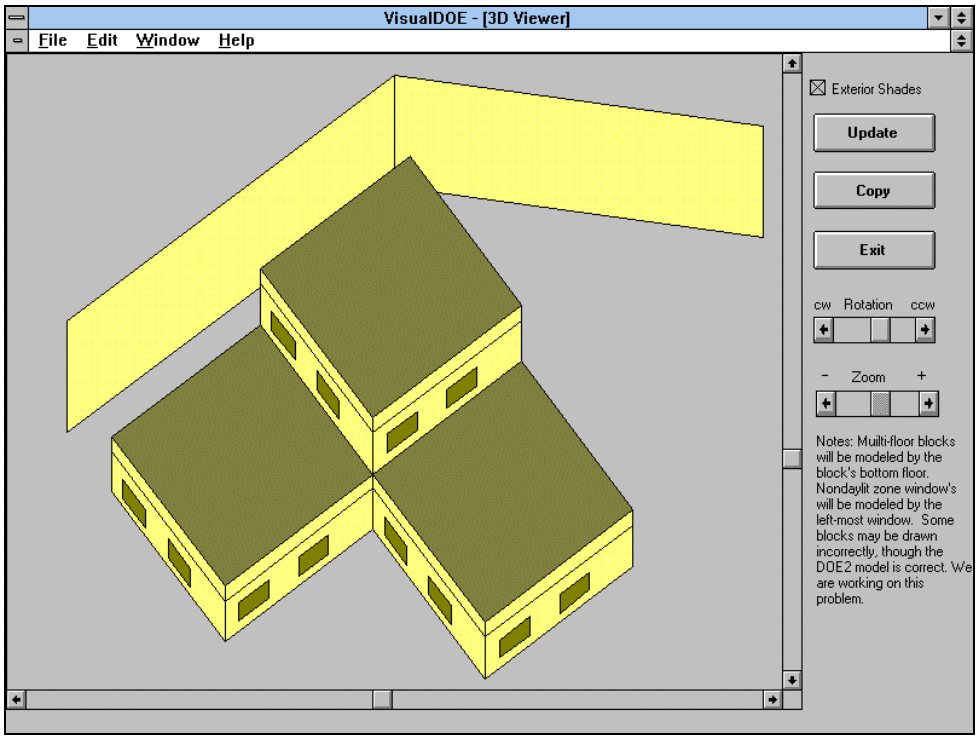


VisualDOE 2.5 has the ability to model exterior lights and two additional loads in your model (Fig. 8). For exterior lights, you enter the peak kW and choose a fraction schedule from the drop-down list box that modifies the peak for each hour. There are four types of miscellaneous energy that you can choose from: electrical, fuel, hot water, and chilled water. The electrical type might be used to model elevators, the fuel type for Bunsen burners in a laboratory, the hot water type to place a load on the central plant boilers, and the chilled water type to place a load on the chilled water plant. By including miscellaneous energy uses, you can better calibrate your model against billing history or other monitored data.

3D Viewer

VisualDOE 2.5 adds the ability to display an isometric image of your model to supplement the plan and elevation views on the Graphic Editor (Fig. 9). You can rotate and zoom your model, including exterior shades, to look at it from different angles. The 3D Viewer can remain open with the Graphic Editor, allowing you to see changes to your model in three dimensions as you edit it.

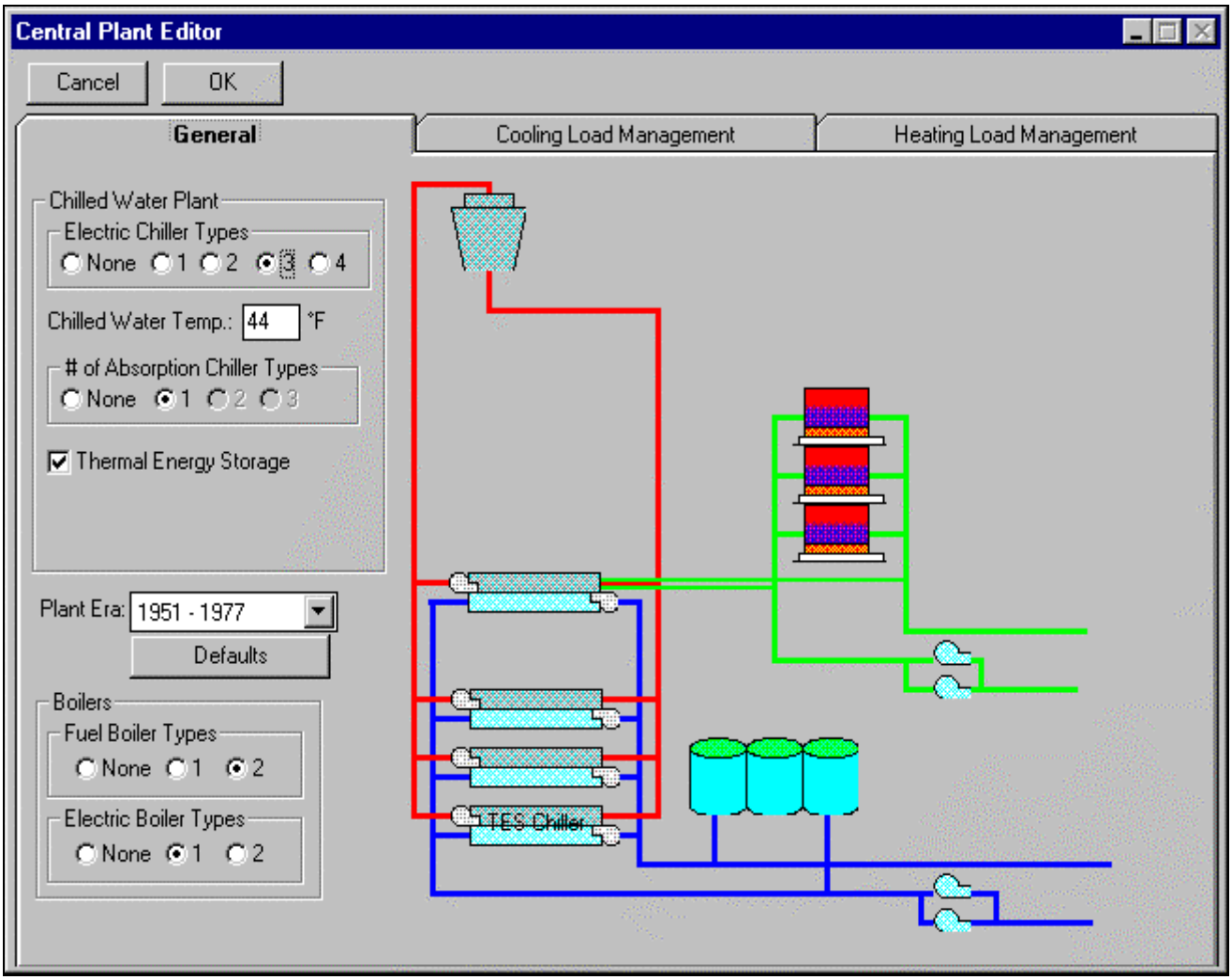
Figure 9 - 3D Viewer Showing Exterior Shades



Central Plant Editor

VisualDOE 2.5 provides several enhancements to the Central Plant Editor (Fig. 10) including thermal energy storage, absorption chillers, and time-dependent load management. With these new features, you can model just about any central plant configuration.

Figure 10 - Central Plant Editing Form

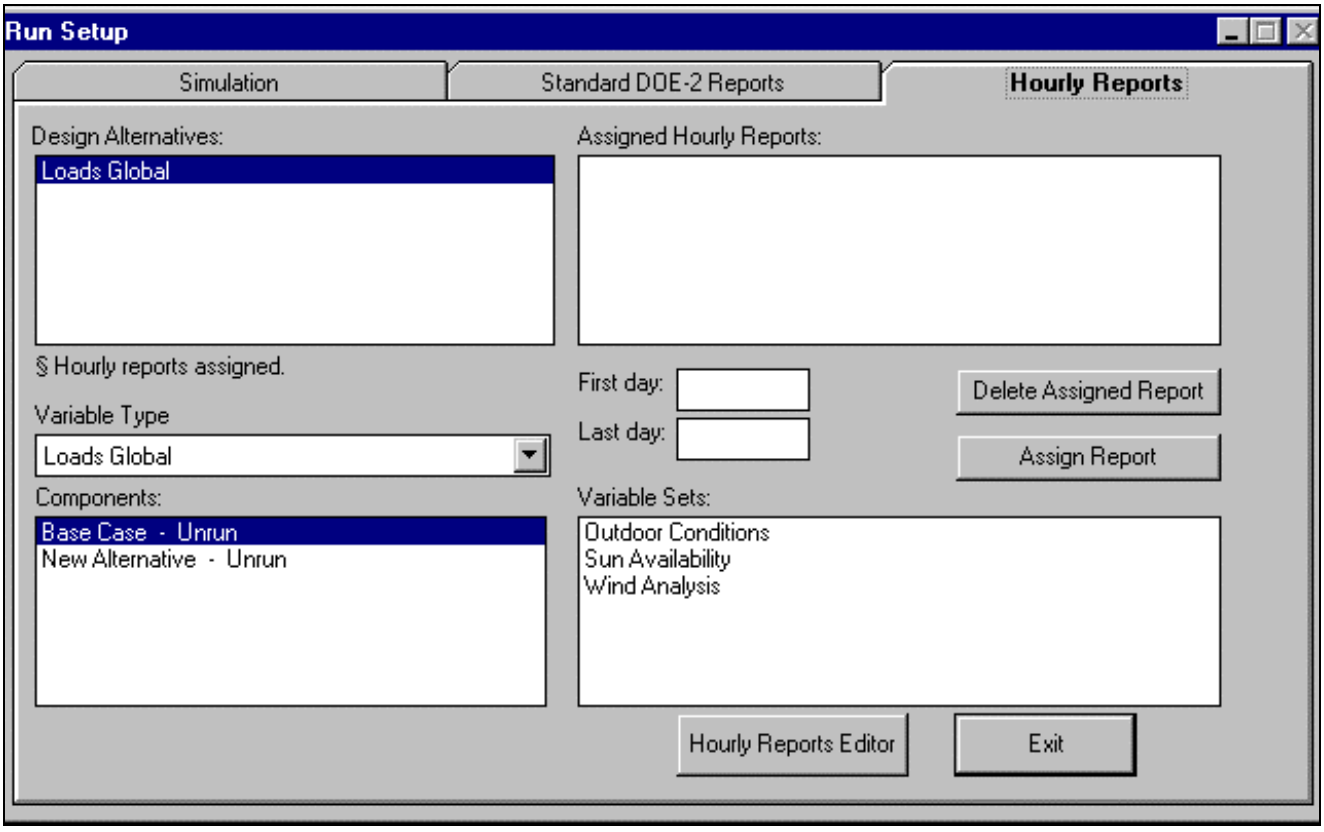


Hourly Reports

VisualDOE 2.5 allows you to generate and graph hourly data, an extremely important feature for analyzing results and verifying the correct operation of equipment and controls. A new program module was added to create hourly reports and store them in the library, just like construction assemblies and other library components. Hourly reports can be specified from the Run|Setup form just like standard DOE-2 reports. The process is a bit more complicated, however, because often hourly reports must be assigned to a particular thermal zone, HVAC system or other building component. The general process in assigning hourly reports is to choose a design alternative, hourly report type, hourly report, and component such as a zone or HVAC system. Once the selections are made, just click the Assign Report command button.

Hourly report data are stored in a special file with the extension *.h0 for the base case, *.h1 for the first design alternative, etc. These files can be read by spreadsheets for subsequent processing, or the data can be plotted by VisualDOE in the new File|Graphs option (see Graphing Results, above).

Figure 11 - Assigning Hourly Reports



How to Acquire VisualDOE 2.5

Contact Charles Eley at Eley Associates, 142 Minna Street, San Francisco, CA 94105. Ph: (415) 957-1977, Fx: (415) 957-1381, email celey@eley.com. You may download a demo of VisualDOE 2.5 from the Eley Associates website at http://www.eley.com

Recent Reports: SPARK, Light Pipes and Light Shelves, the Building Design Advisor

This SPARK-related report is available from Kathy Ellington; fax her at (510) 486-4089.

LBNL-39098

Two- and Three-Dimensional Natural and Mixed Convection Simulation Using Modular Zonal Models

by
E. Wurtz
Laboratoire d'Etudes Pour la Thermique Appliquée au Bâtiment
Université de la Rochelle
Rochelle, France

J.-M. Nataf and F.C. Winkelmann
Simulation Research Group
Building Technologies Program
Energy & Environment Division
Lawrence Berkeley National Laboratory
Berkeley, CA 94720

Abstract:
We demonstrate the use of the zonal model approach, which is a simplified method for calculating natural and mixed convection in rooms. Zonal models use a coarse grid and use balance equations, state equations, hydrostatic pressure drop equations, and power law equations of the form $m = CD^n$. The advantages of the zonal approach and its modular implementation are discussed. The zonal model resolution of nonlinear equations systems is demonstrated for three cases: a 2-D room, a 3-D room, and a pair of 3-D rooms separated by a partition with an opening. A sensitivity analysis with respect to physical parameters and grid coarseness is presented. Results are compared to computational fluid dynamics calculations and experimental data.

This report is available from Pat Ross of the LBNL Building Technologies Program. Please fax your request to (510) 486-4089; be sure to include the LBL and DA numbers.

LBL-38133/DA-349

Advanced Optical Daylighting Systems: Light Shelves and Light Pipes

by
L. Beltrán, E. Lee, S. Selkowitz
Energy & Environment Division
Lawrence Berkeley National Laboratory
Berkeley, CA 94720

Abstract:
We present two perimeter daylighting systems that passively redirect beam sunlight further from the window wall using special optical films, an optimized geometry, and a small glazing aperture. The objectives are to increase daylight illuminance levels at 15-30 ft from the window aperture with minimum solar heat gains, and to improve the uniformity of the daylighting luminance gradient across the room under variable solar conditions throughout the year. Designs were developed using a series of computer-assisted ray-tracing studies, laser visualization techniques, and photometric measurements and observations using physical scale models. Bi-directional illuminance measurements in combination with analytical routines were then used to simulate daylight performance for any solar position and were incorporated into DOE-2.1E to evaluate energy savings. Results show increased daylight levels and an improved luminance gradient throughout the

year compared to conventional daylighting
This report is available from Pat Ross of the LBNL Building Technologies Program. Please fax your request to (510) 486-4089; be sure to include the LBL number.

LBL-38584

The Building Design Advisor

by
K.Papamichael, J. LaPorta, H. Chauvet, D. Collins, T. Trzcinski, J. Thorpe, and S. Selkowitz
Building Technologies Program
Energy & Environment Division
Lawrence Berkeley National Laboratory
Berkeley, CA 94720

Abstract:
The Building Design Advisor (BDA) is a software environment that supports the integrated use of multiple analysis and visualization tools throughout the building design process, from the initial schematic design phases to the detailed specification of building components and systems. Based on a comprehensive design theory, the BDA uses an object-oriented representation of the building and its context, and acts as a data manager and process controller to allow building designers to benefit from the capabilities of multiple tools.

The BDA provides a graphical user interface that consists of two main elements: the Building Browser and the Decision Desktop. The Browser allows building designers to quickly navigate through the multitude of descriptive and performance parameters addressed by the analysis and visualization tools linked to the BDA. Through the Browser, you can edit the values of input parameters and select any number of input and/or output parameters for display in the Decision Desktop. The Desktop allows you to compare multiple design alternatives with respect to any number of parameters addressed by the tools linked to the BDA.

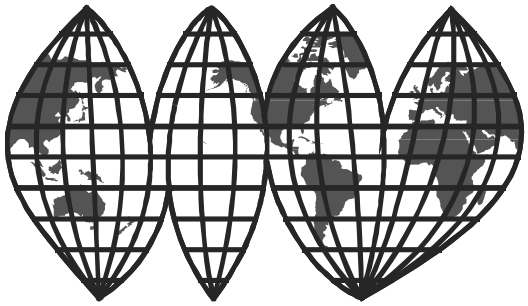
The BDA is implemented as a Windows-based application for personal computers. Its initial version is linked to a Schematic Graphic Editor (SGE), which allows designers to quickly and easily specify the geometric characteristics of building components and systems. For every object created in the SGE, the BDA supplies "smart" default values from a Prototypical Values Database (PVD) for all non-geometric parameters required as input to the analysis visualization tools linked to the BDA. In addition to the SGE and the PVD, the initial version of the BDA is linked to a daylight analysis tool, an energy analysis tool, and a multimedia Case Studies Database (CSD). The next version of the BDA will be linked to additional tools, such as a photo-accurate rendering program and a cost analysis program. Future versions will address the whole building life cycle and will be linked to construction, commissioning, and building monitoring tools.

[*Go to the BDA web page at* ***http://eande.lbl.gov/BTP/BDA/BDA.html*** *and explore the links to the Schematic Graphic Editor, the Prototypical Values Database, and the Case Studies Database*]

Index to the User News

Vol. 1, No. 1 (August 1980) through Vol. 17, No. 4 (Winter 1996)

KEY: The Index lists User News volumes, issues, and page numbers as follows: Title of the article, program version that was current when article appeared, Volume, Number (No. 1 = Spring, No. 2 = Summer, No. 3 = Fall, No. 4 = Winter), and page number. For example, the entry "Advanced Simulation (2.1C)...7:4,4-8" (when applicable) means that the article was entitled "Advanced Simulation" and it was printed when DOE-2.1C was the current version of the DOE-2 program; the article was printed in Volume 7:Number 4, on pages 4 through 8.



I B P S A
International Building Performance Simulation Association

Fifth International Conference
Prague, Czech Republic
September 8-10, 1997

BUILDING SIMULATION '97

Computer modeling and simulation is a most powerful approach for addressing the complex interactions encountered in buildings and the systems that service them. Modeling and simulation are evolving rapidly, and techniques not feasible just a few years ago are now becoming commonplace. The International Building Performance Simulation Association (IBPSA) was founded in 1986 to advance and promote the science of building performance simulation, with application to the design, construction, operation, and evaluation of new and existing buildings worldwide.

CONFERENCE THEMES

- Fundamentals and approaches for building related phenomena, such as heat, moisture, air, fluid and power flow, artificial and day lighting, fire acoustics, indoor air quality and environmental impact.
- Implementation, integration, and quality assurance of modeling and simulation tools.
- Application of modeling and simulation in design of new and refurbished buildings and HVAC systems.
- Integration of modeling and simulation in higher education.
- Use of modeling and simulation in practice.

The conference program will allow for hardware and software demonstrations, and a side-program is envisaged for student presentations of short papers.

REGISTRATION FEES

The registration fee includes conference attendance, proceedings, lunches, morning and afternoon refreshments, early-bird reception, welcome reception, and banquet. The accompanying persons registration excludes conference attendance and proceedings.
IBPSA members will receive a USD 25 discount.

Before 15 May 1997		**After 15 May 1997**	
ECE participants	USD 125	Late registration	USD 300
Full time students	USD 125	Accompanying persons	USD 100
Early registration	USD 250		

VENUE
Prague is the capital and center of industry, science, and culture of the Czech Republic. Prague is located in the center of Europe and belongs among the best preserved historical cities with unique collections of architectural and cultural monuments. BS '97 will be held at the Czech Technical University in Prague (CTU), situated just north of the center of the city.

ADVANCE REGISTRATION FORM
If you wish to attend Building Simulation '97 as an author or a participant, or if you would like to be on the mailing list to receive further information, please return this advance registration form.

Name	
Address	
Country	Email
Phone	Fax

	I am interested in BS '97
	I plan to attend BS '97
	I will be accompanied by person(s)
	I am interested in cultural tours
	I would like to demonstrate hardware/software

CONFERENCE SECRETARIAT
Mail the advance registration form and address all inquiries to:

Secretariat Building Simulation '97
Faculty of Mechanical Engineering
Dept. of Environmental Engineering
Czech Technical University in Prague
Technicka 4
166 07 PRAGUE 6
Czech Republic

phone/fax +42 2 2345 5616

email bs97@fsid.cvut.cz

news: http://www.fsid.cvut.cz/bs97

Check out these URLs before you plan your trip to Prague...

http://metro.jussieu.fr:10001/bin/cities/english	This subway navigator allows you to find routes in subway systems in various cities around the world.
http://maps.yahoo.com/yahoo/	Locate a detailed street map from almost any street address in the United States.
http://www.xe.net/currency/	Universal currency converter

"Building Loads Analysis and System Thermodynamics"

blastnews

The **Building Loads Analysis and System Thermodynamics (BLAST)** system is a comprehensive set of programs for predicting energy consumption and energy system performance and cost in buildings. The BLAST system was developed by the U.S. Army Construction Engineering Research Laboratory (USACERL) under the sponsorship of the Department of the Air Force, Air Force Engineering and Services Center (AFESC), and the Department of the Army, Office of the Chief of Engineers (OCE). After the original release of BLAST in December 1977, the program was extended and improved under the sponsorship of the General Services Administration, Office of Professional Services; BLAST Version 2.0 was released in June 1979. Under the sponsorship of the Department of the Air Force, Aeronautical System Division, and the Department of Energy, Conservation and Solar Energy Office, the program was further extended; BLAST Version 3.0 was completed in September 1980. Since 1983, the BLAST system has been supported and maintained by the BLAST Support Office at the University of Illinois at Urbana-Champaign.

BLAST can be used to investigate the energy performance of new or retrofit building design options of almost any type and size. In addition to performing peak load (design day) calculations necessary for mechanical equipment design, BLAST also estimates the annual energy performance of the facility, which is essential for the design of solar and total energy (cogeneration) systems and for determining compliance with design energy budgets. Repeated use of BLAST is inexpensive; it can be used to evaluate, modify, and re-evaluate alternate designs on the basis of annual energy consumption and cost.

The BLAST analysis program contains three major subprograms:

- The Space Load Predicting subprogram computes hourly space loads in a building based on weather data and user inputs detailing the building construction and operation.
- The Air Distribution System Simulation subprogram uses the computed space loads, weather data, and user inputs describing the building air- handling system to calculate hot water, steam, gas, chilled water, and electric demands of the building and air-handling system.
- The Central Plant Simulation subprogram uses weather data, results of the air distribution system simulation, and user inputs describing the central plant to simulate boilers, chillers, on-site power generating equipment and solar energy systems; it computes monthly and annual fuel and electrical power consumption.

BLAST Support Office (BSO)
30 Mechanical Engineering Bldg
University of Illinois
1206 West Green Street
Urbana, IL 61801

Telephone: (217) 333-3977
FAX: (217) 244-6534
email: support@blast.bso.uiuc.edu
http://www.bso.uiuc.edu

Heat Balance Loads Calculator (HBLC)
The BLAST graphical interface (HBLC) is a Windows-based interactive program for producing BLAST input files. HBLC allows the user to visualize the building model as it is developed and modify previously created input files. Within HBLC, each story of the building is represented as a floor plan which may contain several separate zones. Numerous other building details may be investigated and accessed through simple mouse operations. On-line helps provide valuable on-the-spot assistance that will benefit both new and experienced users. HBLC is an excellent tool which will make the process of developing BLAST input files more intuitive and efficient. You can download a demo version of HBLC (for MS Windows) from the BLAST website (User manual included!).
A FREE UPGRADE IS AVAILABLE to registered users, as of July 11. To obtain a password and instructions for downloading, email to: support@blast.bso.uiuc.edu, or call (217) 333-3977. This upgrade may also be obtained by post for a nominal fee.

WINLCCID 96
LCCID (Life Cycle Cost in Design) has been a standard in the DoD community since its initial release in 1986. LCCID was developed to perform Life Cycle Cost Analyses (LCCA) for the Department of Defense and their contractors, yet it goes far beyond being just a DoD study tool by providing many features of a general purpose life cycle costing tool. With LCCID, it's easy to carry out "what-if" analyses based on variables such as present and future costs and/or maintenance and repair costs. LCCID allows an analysis based on standard DoD procedures and annually updated escalation factors as well as Energy Conservation Investment Program (ECIP) LCCA. the WinLCCID96 life cycle cost program [See *User News* Vol. 16, No. 4, p. 5]. You can download a demo version of WINLCCID 96 (for MS Windows) from the BLAST website.

PC BLAST Package
The standard PC BLAST Package includes the following programs: BLAST, HBLC, BTEXT, WIFE, CHILLER, Report Writer, Report Writer File Generator, Comfort Report program, and the Weather File Reporting Program. A soft copy of the BLAST manual will be included as help files with the software. The Portable BLAST Package does not include HBLC or HBLC source.

Executable version of BLAST Software Package for an IBM 386/486/Pentium with a Numeric Co-Processor	3B386E3-0695	$950.00
PORTABLE BLAST (on DOS Formatted Disks) Source code plus PC Executables and HBLC	3BPORA3-0695	$1500.00
Separate Programs	**Order Number**	**Price**
WINLCCID 96 (initial purchase)	3LCC3-0396	$295.00
WINLCCID 96 (update from Level 92)	4LCC3-0396	$195.00
SOLFEAS (initial purchase)	3SOL3-1194	$100.00
Control Profile Macros for Lotus or Symphony	3010-0388	$35.00
Design Week Creation Program	3DWEE3-0494	$35.00
BLAST 3.0 Documentation Set (Enter Quantity)		
Printed version in a 3-ring binder	1001-0695	$250.00

The last four digits of the catalog number indicate the month and year the item was released or published. This will enable you to see if you have the most recent version. All software will be shipped on 3.5" high density floppy disks unless noted otherwise.

DOE-2 DIRECTORY

Program Related Software and Services

Contact the vendors for prices and ordering information

Mainframe and Workstation Versions of DOE-2

DOE-2.1D and 2.1E (Source code, executable code and documentation) For 2.1E DEC-VAX, Order #000158-DOVAX-02 For 2.1E SUN-4, Order #000158-SUN-0000 For 2.1D DEC-VAX, Order #000158-D6220-01 For a complete listing of the software available from ESTSC order their "Software Listing" catalog ESTSC-2. [See *User News* Vol. 16, No. 3, p. 21]	Energy Science / Technology- Software Center (ESTSC) P.O. Box 1020 Oak Ridge, TN 37831-1020 Phone: (615) 576-2606 Fax: (615) 576-2865 email:ESTSC@ADONIS.OSTI.GOV http://www.doe.gov/html/osti/estsc/estsc.html
FTI-DOEv2.1E (Source code and documentation) Combined source code package for both VAX and SUN versions of DOE-2.1E. Available on most distribution formats and for most operating systems (1/4" QIC tape, TK50 tape, 3.5" floppy, etc). Note: this is the distribution package only, no executables. Complete documentation for DOE-2.1E, digitally reproduced, spiral bound, and separated into multi-volume sets. [See *User News* Vol. 12, No. 4, p. 16]	Finite Technologies, Inc 3763 Image Drive Anchorage, AK 99504 Contact: Scott Henderson Phone: (907) 333-8933 Fax: (907) 333-4482 email: info@finite-tech.com http://www.finite- tech.com/fti/home.htmld

PC Versions of DOE-2

ADM-DOE2 ADM-DOE2 (DOE-2.1E) is compiled for use on 386/486 PCs with a math co-processor and 4MB of RAM. It runs in a DOS or Windows environment and is a highly reliable and tested version of DOE-2 which contains all of the 1994/95 enhancements to the program. The package contains everything needed to run the program: program files, utilities, sample input files, and weather files. More than 300 weather files are available (TMY, TRY, WYEC, CTZ formats) for the U.S. and Canada. [See *User News* Vol. 7, No. 2, p. 6]	ADM Associates, Inc. 3239 Ramos Circle Sacramento, CA 95827 Contact: Marla Sullivan, Sales Phone: (916) 363-8383 Fax: (916) 363-1788
CECDOEDC (Version 1.0A) A microcomputer version of DOE-2.1D with a pre- and post-processor designed strictly for compliance use within the State of California. It generates some of the standard compliance forms as output. Order P40091009 for the CECDOEDC Program with Manuals. Order P40091010 for the DOE-2.1 California Compliance Manual. [See *User News* Vol. 12, No. 4, p. 13]	MS: 13 -- Publication Office California Energy Commission P.O. Box 944295 Sacramento, CA 94244-2950 Phone: (916) 654-5106
DOE-24/Comply-24 DOE-24 is a special DOE-2 release that is both a California-approved compliance program for the state's non-residential energy standards, and a stand-alone version of DOE-2.1E that includes a powerful yet easy-to-use input preprocessor. A demonstration program is available upon request. [See *User News* Vol. 12, No. 2, p. 2]	Gabel-Dodd Associates 1818 Harmon Street Berkeley, CA 94703-2416 Contact: Rosemary Howley Phone: (510) 428-0803 Fax: (510) 428-0324

Caveat : We list third-party DOE-2-related products and services for the convenience of program users, with the understanding that the Simulation Research Group does not have the resources to check the DOE-2 program adaptations and utilities for accuracy or reliability.

PC Versions of DOE-2 (continued)

DOE-Plus DOE-Plus, a complete implementation of DOE-2.1D, is used to interactively input a building description, run DOE-2, and plot graphs of simulation results. Interactive error checking, context-sensitive help for all DOE-2 keywords, a 3-D view of the building that can be rotated, and several useful utilities. Also from ITEM Systems: **Demand Analyzer,** uses templates of building types and vintages to simplify DOE-2 input requirements. Online help feature. **Prep,** a batch preprocessor, ideal for parametric studies, that enables conditional text substitution, expression evaluation, and spawning of other programs. [See *User News* Vol. 11, No. 4, p. 4 and Vol. 13, No. 2, p. 54, and Vol. 16, No. 1, p. 28-32	ITEM Systems 1402 - 3rd Avenue, #901 Seattle, WA 98101 Contact: Steve Byrne Phone: (206) 382-1440 Fax: (206) 382-1450 email: byrne@item.com
EZDOE EZDOE is an easy-to-use PC version of DOE-2.1D. It provides full screen, fill in the blank data entry, dynamic error checking, context-sensitive help, mouse support, graphic reports, a 750-page user manual, extensive weather data, and comprehensive customer support. EZDOE integrates the full calculation modules of DOE-2 into a powerful, full implementation of DOE-2 on DOS-based 386 and higher computers. [See *User News* Vol. 14, No. 2, p. 10 and No. 4, p. 8-14]	Elite Software, Inc. P.O. Drawer 1194 Bryan, TX 77806 Contact: Bill Smith Phone: (409) 846-2340 Fax: (409) 846-4367 email: 76070.621@compuserve.com
FTI-DOEv2.1E Highly optimized version of DOE-2.1E software, available for most computing systems. Current support: MSDOS and Windows 3.x, Windows NT, OS/2, RS/6000 (AIX), NeXT, SUN, UNIX (most systems). Call for platforms not listed. Documentation and weather files are available. Also FTI-DOEv2.1E source code, highly optimized and portable version; will compile for most systems. [See *User News* Vol. 12, No. 4, p. 16]	Finite Technologies, Inc 821 N Street, #102 Anchorage, AK 99501 Contact: Scott Henderson Phone: (907) 272-2714 Fax: (907) 274-5379 email: info@finite-tech.com http://www.finite-tech.com/fti/home.htmld
MICRO-DOE2ä MICRO-DOE2 (2.1E), running in a DOS or Windows environment, is a widely used, reliable, and tested PC version of DOE-2.1E. It includes automatic weather processing, batch file creation, and a User's Guide with instructions on how to set up a RAM drive. System requirements: 386/486 PC with 4 MB of RAM and math co-processor. Also from ACROSOFT/CAER Engineers: **NETPath**, a network edition of MICRO-DOE2 for up to five users, allows you to store and run DOE-2 application files on one machine using input files from another machine. The result is improved space usage and project file management. **POWERPath**, for single machines, allows you to keep MICRO-DOE2 application files in one directory and submit input from any other directory. **BDL Builder** is a user-friendly Windows-implemented pre-processor for DOE-2.1E that allows the description of specific building and HVAC characteristics with numeric input by preparing databases, or building blocks, and then selecting records from the databases to assemble a complete input. **E2BB** translates existing DOE-2.1E text input to BDL Builder. **Weather Files** for most U.S., Canadian, and European cities are available in various formats, including TRY, TMY, CTZ, and WYEC. [See *User News* Vol. 7, No. 4, p. 2; Vol. 11, No. 1, p. 2; Vol. 15, No. 1, p. 8; Vol. 15, No. 3, p. 4; Vol. 16, No. 2, p. 1,7; Vol. 16, No. 4, p. 7-8]	ACROSOFT / CAER Engineers 814 Eleventh Street Denver, CO 80401 Contact: Don Croy Phone: (303) 279-8136 Fax: (303) 279-0506 email: 102447.2611@COMPUSERVE.COM

PC Versions of DOE-2 (continued)

PRC-DOE2 A fast, robust and up-to-date PC version of DOE-2.1E. Runs in extended memory, is compatible with any VCPI compliant memory manager and includes its own disk caching. 377 weather data files available (TMY, TRY, WYEC, CTZ) for the U.S. and Canada **PRC-TOOLS** is a set of PC programs that aids in extracting, analyzing and formatting hourly DOE-2 output. Determines energy use, demand, and cost for any number of end-uses and periods. Automatically creates 36-day load shapes. Custom programs also available.	Partnership for Resource Conservation 140 South 34th Street Boulder, CO 80303 Contact: Paul Reeves Phone: (303) 499-8611 FAX: (303) 554-1370 email: paulreeves@aol.com
VisualDOE 2.5 for Windows ™ VisualDOE 2.5, which uses DOE-2.1E as the calculation engine, enables architects and engineers to quickly evaluate the energy savings of HVAC and other building design options. Program is supported by a graphical interface and on-line help. Program includes climate data for the 16 California weather zones. A demo can be downloaded from http://www.eley.com. [See *User News* Vol. 15, No. 2, p. 10; Vol. 16, No. 4, p. 9-16; Vol. 17, No. 4, p. 8-13]	Eley & Associates 142 Minna Street San Francisco, CA 94105 Charles Eley or John Kennedy Phone: (415) 957-1977 / Fax: -1381 email: celey@eley.com http://www.eley.com

Pre- and Post-Processors for DOE-2

DrawBDL DrawBDL, Version 2.02, is a graphic debugging and drawing tool for DOE-2 building geometry; it runs on PCs under Microsoft Windows. DrawBDL reads your BDL input and makes a rotatable 3D drawing of your building with walls, windows, and building shades shown in different colors for easy identification. [See *User News*, Vol. 14, No. 1, p. 5-7, Vol. 14, No. 4, p. 16-17, and Vol. 16, No. 1, p.37]	Joe Huang & Associates 6720 Potrero Avenue El Cerrito, CA 91364 Contact: Joe Huang Phone/Fax:: (510) 236-9238
Visualize-IT Visual Data Analysis Tools The ***Energy Information Tool*** is a Microsoft Windows 3.1 program for looking at and understanding metered or DOE-2.1E hourly input data. It provides the unprecedented ability to see all 8760 (or 35040) data points for a year's worth of data. You get an overview of the data with an EnergyPrint™ and can then explore the data with a variety of tools including load shapes, load duration curves, etc. This program requires a 486 computer and SVGA graphics capabilities. The ***Calibration Tool*** is a Microsoft Windows 3.1 program for comparing DOE-2.1E hourly output data to total load and/or end-use metered data. Options include monthly demand and load 2D graphs, maximum and seasonal load shapes, average load profiles, end use residuals, monthly average week and weekend days, and dynamic comparison load shapes. This program requires a 486 computer and SVGA graphics capabilities. [See *User News* Vol. 17, No. 2, p. 2-6]	RLW Analytics, Inc. 1055 Broadway, Suite G Sonoma, CA 95476 Contact: Jim McCray Pat Bailey Jedd L. Parker Phone: (707) 939-8823 Fax: (707) 939-9218 email: info@rlw.com www: http://www.rlw.com
D O E 1 2 3 Uses Lotus 1-2-3 to graphically display DOE-2.1D output as bar charts, pie charts, and line graphs. [See *User News* Vol. 10, No. 3, p. 5]	Ernie Jessup 4977 Canoga Avenue Woodland Hills, CA 91364 Phone: (818) 884-3997
Graphs for DOE-2 2-D, 3-D, hourly, daily, and psychrometric plots [See *User News* Vol. 13, No. 1, p. 5]	Energy Systems Laboratory Texas A&M University College Station, TX 77843 Contact: Jeff Haberl Phone : (409) 845-6065 Fax: (409) 862-2762
Pre-DOE A math pre-processor for BDL.	Nick Luick 19030 State Street Corona, CA 91719 Phone: (714) 278-3131

TOOLS AND TRAINING

User News **(a quarterly newsletter)** Sent without charge, the newsletter prints documentation updates and changes, bug fixes, inside tips on using the programs more effectively, and articles of special interest to users. Regular features include a directory of program-related software and services and an order form for documentation. The winter issue features an index of articles printed in all the back issues. Also available electronically at http://eande.lbl.gov/BTP/SRG/UNEWS	Simulation Research Group Bldg. 90, Room 3147 Lawrence Berkeley National Laboratory Berkeley, CA 94720 Contact: Kathy Ellington Fax: (510) 486-4089 email: kathy@gundog.lbl.gov
Help Desk Bruce Birdsall Call or fax Bruce Birdsall if you have a question about using DOE-2. If you need to fax an example of your problem to Bruce, please be sure to telephone him prior to sending the fax. This is a free service provided by the Simulation Research Group at Lawrence Berkeley National Laboratory.	Bruce Birdsall Phone/Fax: (510) 829-8459 Monday through Friday 10 a.m. to 3 p.m. Pacific Time
Training DOE-2 courses for beginning and advanced users. DOE-2 training for small groups and individuals.	 Energy Simulation Specialists 64 E. Broadway, Suite 230 Tempe, AZ 85282 Contact: Marlin Addison Phone: (602) 967-5278 Gary H. Michaels, P.E. 1512 Crain Street Evanston, IL 60202 Phone: (708) 869-5859 email: g_michaels@msn.com
Instructional DOE-2 Video and Manual Takes you step-by-step in DOE-2.1D input preparation and output interpretation.	Contact: Dr. Moncef Krarti, Acting Director JCEM/U. Colorado CEAE Dept CB 428 Boulder, CO 80309-0428 Phone: (303) 492-3389 or 7317

DOE-2.1E Bug Fixes via FTP

If you have Internet access you can obtain the latest bug fixes to the LBNL version of DOE-2.1E by anonymous ftp. Here's how...

ftp to either gundog@lbl.gov or to 128.3.254.10
login: *type* anonymous
passwd: *type in your email address*

After logging on, go to directory pub/21e-mods ; bug fixes are in files that end with **.mod** . A description of the fixes is in file **VERSIONS.txt** in directory **pub** . Each fix has its own version number, ***nnn*** , which is printed out as DOE-2.1E- *nnn* on the DOE-2.1E banner page and output reports when the program is recompiled with the fix. You may direct questions about accessing or incorporating the bug fixes to Ender Erdem (ender@gundog.lbl.gov).

WEATHER RESOURCES

TMY2 weather data for DOE-2. ENERGOS will provide TMY2 data for 239 cities converted for use with DOE-2 for PC versions of the program (DOE-2.1C through DOE-2.1E).	Kurmit Rockwell ENERGOS 1705-14th Street, #401 Boulder, CO; 80302 Phone: (303) 499-7907 / Fax: (303) 449-7605
Comprehensive collection of **TRY**, **TMY** and **CTZ** weather file libraries, from NCDC, which can be used on all PC versions of DOE-2. Includes original source data and pre-formatted packed versions on a single IBM format CD. For Canadian users, the CD contains five weather files representing the five climate regions established by the Canadian energy codes. Individual sites available.	Jenny Lathum or Martyn Dodd EnergySoft 100 Galli Drive, Suite 1 Novato, CA 94949 Phone: (800) 467-4738 Fax: (415) 883-5970
European Weather Files	Andre Dewint Alpha Pi, s.a. rue de Livourne 103/12 B-1050 BRUXELLES, Belgium Phone: 32-2-649-8359 / Fax: 32-2-649-9437
TMY data sets - download from the World Wide Web **TMY2** data sets - download from the World Wide Web	TMY: http//oipea-www.rutgers.edu/html_docs/TMY/tmy.html TMY2: http://rredc.nrel.gov/solar/old_data/nsrdb/tmy2
TMY (Typical Meteorological Year) **TRY** (Test Reference Year)	National Climatic Data Center 151 Patton Avenue, #120 Asheville, NC 28801 Phone: (704) 271-4871 order / Fax 271-4876
CTZ (California Thermal Climate Zones)	California Energy Commission Bruce Maeda, MS-25 1516-9th Street Sacramento, CA 95814-5512 1-800-772-3300 Energy Hotline
WYEC (Weather Year for Energy Calculation)	ASHRAE 1791 Tullie Circle N.E. Atlanta, GA 30329 Phone: (404)636-8400 / Fax: (404)321-5478
Canadian Weather Files in WYEC2 Format [Note: the original long-term data sets, up to 40 years of data, from which the CWEC files were derived can also be obtained directly from Environment Canada. Contact Mr. Robert Morris at (416) 739-4361.]	Dr. Didier Thevenard Watsun Simulation Lab University of Waterloo Waterloo, Ont., N2L-3G1 Canada Phone: (519) 888-4904 / Fax: (519) 888-6197 watsun@helix.watstar.uwaterloo.ca

DOE-2 ENERGY CONSULTANTS

Arizona				
Chuck Sherman	Energy Simulation Specialists	64 East Broadway, #230	Tempe, AZ 95282	(602) 967-5278
California				
George Marton		1129 Keith Avenue	Berkeley, CA 94708	(510) 841-8083
Jeff Hirsch	James J. Hirsch Associates	12185 Presilla Road	Camarillo, CA 93012	(805) 532-1045
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Robert E. Gibeault	A-TEC	5515 River Avenue, # 301	Newport Beach, CA 92663	(714) 548-6836
Martyn C. Dodd	Gabel Dodd Associates	100 Galli Drive, # 1	Novato, CA 94949	(415) 883-5900
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Joel Neymark, P.E.		2140 Ellis Street	Golden, CO 80401	(303) 384-3672
Norm Weaver	Interweaver Consulting	P.O. Box 775444	Steamboat Spgs, CO 80477	(970) 870-1710
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Adrian Tuluca	Steven Winter Associates	50 Washington Street	Norwalk, CT 06854	(203) 852-0110
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Philip Wemhoff		1512 South McDuff Avenue	Jacksonville, FL 32205	(904) 632-7393
Illinois				
Michael P. Doerr	Skidmore Owings Merrill LLP	224 S Michigan Ave # 1000	Chicago, IL 60604	(312) 360-4623
Gary H. Michaels, P.E.		1512 Crain Street	Evanston, IL 60202	(708) 869-5859
Prem N. Mehrotra	General Energy Corp.	230 Madison Street	Oak Park, IL 60302	(708) 386-6000
Robert Henninger, P.E.	GARD Analytics, Inc.	1028 Busse Highway	Park Ridge, IL 60068-1802	(847) 698-5686
Kansas				
Brian A. Rock, Ph.D., P.E.	Marvin Hall	University of Kansas	Lawrence, KS 66045-2222	(913) 864-3434
Missouri				
Mike Roberts	Roberts Engineering Co.	11946 Pennsylvania	Kansas City, MO 64145	(816) 942-8121
Montana				
Michael W Harrison, P.E.		139 Bluebird Lane	Whitehall, Montana 59759	(406) 287-5370
New York				
J. Fireovid, K. Yousef	SAIC Energy Solutions Div.	1 Marcus Boulevard	Albany, NY 12205	(518) 458-2249
North Carolina				
Hank Jackson, P.E.		P.O. Box 675	Weaverville, NC 28787-0675	(704) 658-0298
Texas				
Jeff S. Haberl	Energy Systems Lab	Texas A&M University	College Stn., TX 77843-3123	(409) 845-6065
Washington				
Steve Byrne	ITEM Systems	1402 - 3rd Avenue, #901	Seattle, WA 98101	(206) 382-1440
Gregory Banken, P.E.	Q-Metrics, Inc.	P.O. Box 3016	Woodinville, WA 98072	(205) 915-8590

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Andre Dewint rue de Livourne 103/12 B-1050 BRUXELLES Belgium	Gerhard Zweifel (GZweifel@ztl.ch) Zentralschweizerisches Technikum Luzern (ZTL) Abt. HLK CH-6048 Horw Switzerland
Curt Hepting, P.Eng. EnerSys Analytics 3990 Lynn Valley Road North Vancouver, B.C. V7K 2S9 Canada	Joerg Tscherry Building Equipment Section 175 EMPA 8600 Dubendorf Switzerland
Dejan Radoicic D. W. Thomson Consultants, Ltd. 1985 West Broadway Vancouver, BC V6J 4Y3 Canada	Neil A. Caldwell, P.Eng. Tescor Pacific Energy Services, Inc. 200-1985 West Broadway Vancouver, BC V6J 4Y3 Canada

DOE-2 RESOURCE CENTERS

The people listed here have agreed to be primary contacts for DOE-2 program users in their respective countries. Each resource center has the latest program documentation, all back issues of the User News, and recent LBNL reports pertaining to DOE-2. These resource centers will receive copies of all new reports and documentation. Program users can then make arrangements to get photocopies of the new material for a nominal cost. We hope to establish resource centers in other countries; please contact us if you are interested in establishing a center in your area.

South America Prof. Roberto Lamberts Universidade Federal de Santa Catarina Campus Universitario--Trindade Cx. Postal 476 88049 Florianopolis SC BRASIL Telephone: (55)482-31-9272 Fax: (55)48-231-9770 email: Lamberts@ecv.ufsc.BR	**Australasia** Dr. Deo K. Prasad/P. C. Thomas SOLARCH University of New South Wales P.O. Box 1 Kensington, N.S.W. 2033 AUSTRALIA Telephone: (61)-2-697-5783 (P.C. Thomas) Fax: (61) 2-662-4265 or -1378 email: PC.Thomas@unsw.EDU.AU
Portugal, Spain, Italy, and Greece Antonio Rego Teixeira ITIME Unidade de Energia Estrada do Paco do Lumiar 1699 Lisboa PORTUGAL Telephone: (351) 1-716-4096 Fax: (351) 1-716-4305 email: itime.ue@mail.telpac.pt	**Australia** Murray Mason ACADS BSG 16 High Street Glen Iris VIC. 3146 AUSTRALIA Telephone: (61) 885 6586 Fax: (61) 885 5974
Singapore, Malaysia, Indonesia, Thailand, and the Philippines WONG Yew Wah, Raymond Nanyang Technological University School of Mechanical and Production Engineering Nanyang Avenue Singapore 2263 REPUBLIC OF SINGAPORE Telephone: (65)799-5543 Fax: (65)791-1859 email: mywwong@ntuvax.ntu.ac.sg	**Germany** B. Barath or G. Morgenstern BARATH and WAGNER Rudolf-Diesel-Strasse 2, 40670 Meerbusch GERMANY Telephone: (49) 2159 528041 Fax: (49) 2159 528043
Hong Kong, China, Taiwan, Japan and Korea Dr. Sam Chun-Man HUI or K.P. Cheung Department of Architecture University of Hong Kong Pokfulam Road HONG KONG http://arch.hku.hk/research/BEER/doe2/doe2.htm Telephone: (852) 2859-2133 (direct to Sam Hui) Fax: (852) 2559-6484 email: CMHUI@HKUCC.HKU.HK	**Switzerland** René Meldem Meldem Energie SA Ch. de l'Ancienne Pointe 1 CH-1920 Martigny SWITZERLAND Telephone: (41) 26 22 96 96 Fax: (41) 26 22 96 97 email: 106034.630@compuserve.com

World-Wide Web and Internet Sites for Building Energy Efficiency

http://www.bso.uiuc.edu	**BLAST** Support Office
(net) sci.engr.heat-vent-ac	**HVAC** discussion group.
(net) sci.engr.lighting	**Lighting** discussion group.
http://www.energy.ca.gov/energy/cectext/ETEC.html	**California Energy Commission's Energy Technology and Education Center**. See *User News* , Vol. 16, No. 1, p. 42.
http://www.hike.te.chiba-u.ac.jp/ikeda/CIE/publ/110-94.html	**The International Commission on Illumination - CIE** See *User News* , Vol. 16, No. 1, p. 44.
http://www.eren.doe.gov/	**EREN**: Energy Efficiency and Renewable Energy Network of the U.S. Department of Energy . See *User News* , Vol. 16, No. 1, p. 44.
http://www.doe.gov/	**U.S. Department of Energy** . See *User News* , Vol. 15, No. 4, p. 1.
http://www.whitehouse.gov/	**The White House** home page contains an Interactive Citizens Handbook that lists U.S. Government servers by agency. Use this site as a jumping-off point to explore other Federal agencies. See *User News* , Vol. 15, No. 4, p. 1.
http://www.fedworld.gov/	**FedWorld** is the U.S. Government's Federal Information Network home page. It lists web servers, ftp, gopher, and telnet sites and is organized by subject categories. See *User News*, Vol. 16, No. 2, p. 22.
http://www.fedworld.gov/ntis/ntishome.html	**National Technical Information Service** NTIS gathers and markets scientific, technical and business-related information.
http://www.caddet-ee.org	**Center for the Analysis and Dissemination of Demonstrated Energy Technologies** An IEA program for collecting and disseminating information on, energy-efficient and renewable energy technologies. See *User News* , Vol. 16, No. 2, p. 23.
http://crest.org/aceee	**American Council for an Energy-Efficient Economy** A non-profit organization for the advancement of energy efficiency. See *User News* , Vol. 16, No. 2, p. 23.
http://www.ashrae.org	**American Society of Heating, Refrigeration and Air-Conditioning** An international membership organization for HVAC professionals. *User News* , Vol. 16, No. 3, p. 31.
http://www.cisti.nrc.ca/irc/irccontents.html	**[Canadian] Institute for Research in Construction** IRC is part of the NRC, Canada's premier science and technology agency. See *User News* , Vol. 16, No. 3, p. 31.
http://next1.mae.okstate.edu/ibpsa/	**International Building Performance Simulation Association** An international society of building performance simulation professionals. See *User News*, Vol. 16, No. 4, p. 35.
http://www.fsec.ucf.edu/	**Florida Solar Energy Center** State of Florida's energy institute specializing in energy research and education in partnership with private and public organizations. See *User News*, Vol. 17, No. 1, p. 29.
http://www.homeenergy.org	**Home Energy Magazine** An impartial source of analysis to aid the energy practitioner and the public in making informed decisions on energy conservation measures. See *User News*, Vol. 17, No. 1, p. 29 and Vol. 17, No. 4, p. 1.
http://eande.lbl.gov/BTP/WDG/ **WDG/RESFEN/resfen.html** **WDG/SUPERLITE/superlite2.html** **WDG/WDG.html**	**Download Free Fenestration software from LBNL** See *User News*, Vol. 17, No. 1, p. 14. **RESFEN-2.4** - calculates residential fenestration heating and cooling enegy use and costs **SUPERLITE-2.0** - calculates daylight illuminance distributions for room geometries **WINDOW-4.1** - thermal analysis program to characterize window product performance
http://www.energy.ca.gov/reports/title24/index.html	**State of California's Title 24 Building Energy Standards** See *User News*, Vol. 17., No. 2, p. 25.
http://fcn.state.fl.us/fdi/fdi-home.htm	**State of Florida's Design Initiative (FDI)** See *User News*, Vol. 17, No. 2, p. 25.
http://fcn.state.fl.us/fdi/edesign/online/edo.htm	***e-design,*** the online newsletter for Florida's Design Initiative See *User News*, Vol. 17, No. 2, p. 25.
http://www.energy.wsu.edu/ep/ **wsu.edu/ep/eic/** **wsu.edu/ep/eic/eicsoft.htm** **wsu.edu/ep/eic/eicfiles.htm**	The **Energy Program (EP)** of Washington State University. *User News*, Vol. 17, No. 3, p.26. **Energy Ideas Clearinghouse**, 925 Plum St S.E., Olympia, WA 98504-3171 (360) 956-2237 Software and files from the Energy Ideas Clearinhouse More download-able energy software from the Energy Ideas Clearinhouse
http://eande.lbl.gov/CBS/VH/advisor.html	The **Virtual Home Energy Advisor** from LBNL's Center for Building science. Run a quick heating-cooling model and see how much homes in your region can save. See *User News*, Vol. 17, No. 3, p.26.
http://www.pge.com/customer_services/other/pec/homepage/pec.html	Pacific Gas & Electric's **Energy Center** located in San Francisco, CA. See *User News*, Vol. 17, No. 4, p. 35
http://dial.uwaterloo.ca/~watsun/home.htm	**Watsun Simulation Laboratory** was established with the support of the National Research Council of Canada. Its mission is to develop general purpose simulation software for solar energy system simulation performance. See *User News*, Vol. l7, No. 4, p. 35.

* * * Featured Sites This Issue * * *

World-Wide Web Sites for Building Energy Efficiency

THE ENERGY CENTER OF THE PACIFIC GAS & ELECTRIC CO.

851 Howard Street
San Francisco, CA 94103
Phone 415 973-7268
Fax: 415 896-1290
e-mail:energy-center@pge.com
http://www.pge.com/customer_services/other/pec/homepage/pec.html

PG&E's Energy Center, the result of a collaboration among California utilities, regulatory agencies and environmental groups, was created to help local building professionals with all kinds of energy-efficiency matters.

Since it opened in December 1991, the Center has presented over 200 seminars and lectures on energy efficiency. These free programs range from brown-bag lunch talks to classes lasting several days. Classes are prepared by the technical experts at the Center as well as scientists from nearby Lawrence Berkeley National Laboratory and practicing engineers from the Illuminating Engineering Society.

Within PG&E's service area, the Energy Center provides many "back-office" tools for building professionals:

- Two mock-up spaces have ceilings, interior finishes, windows and electric lighting that adjust to allow full-scale comparisons of design alternatives.
- A custom-built Heliodon -- a machine that simulates the sun shining on a surface – helps architects study shading patterns and solar access in over 200 projects.
- Designers can also study daylighting using a rooftop station to measure light and time-lapse videos and record light patterns in scale models.

WATSUN SIMULATION LABORATORY

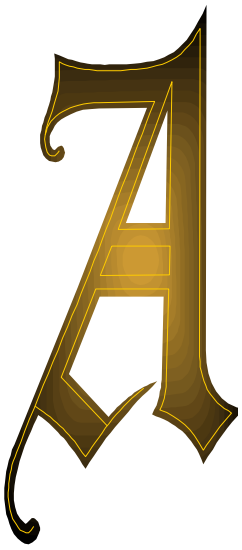
University of Waterloo,
Waterloo, Ont., Canada N2L 3G1
Phone: +1 (519) 888-4904
Fax: +1 (519) 888-6197
http://dial.uwaterloo.ca/~watsun/home.htm

The WATSUN SIMULATION LABORATORY was established in 1980 with the support of the National Research Council of Canada, and since then received ongoing support from Natural Resources Canada to develop general purpose simulation software for solar energy system performance evaluation. The primary objectives of the laboratory are:

- Development of software for the simulation of solar energy systems (WATSUN, WATSUN-PV, WATGEN),
- Weather data processing and distribution,
- Client support and training,
- Educational services in renewable energy.

Watsun is a non-profit unit within the Department of Systems Design Engineering at the University of Waterloo; it maintains close ties with the Solar Thermal Research Laboratory on campus. The laboratory provides assistance to consultants, designers, researchers, and educators in promoting solar energy systems utilization. Watsun attempts to integrate and incorporate research results generated by various research groups with client demands.

In parallel with its simulation activities, the laboratory has also specialized in the processing of radiation and weather data. Typical Meteorological Year (TMY) weather files for the WATSUN and WATSUN-PV programs, as well as Canadian Weather for Energy Calculations (CWEC) weather files for use in building energy calculations, are developed and distributed by Watsun.



DELINE 2.0

The Building Technologies Program at the Lawrence Berkeley National Laboratory is pleased to announce the availability of ADELINE 2.0 (**A**dvanced **D**ay- and **E**lectric **L**ighting **I**ntegrated **N**ew **E**nvironment), the second-generation product of an international collaboration coordinated through the International Energy Agency's Solar Heating and Cooling Program. ADELINE 2.0 integrates the capabilities of a 3D CAD modeling program (SCRIBE) with two lighting analysis tools (SUPERLITE and RADIANCE) on the MS-DOS platform. Software links to whole building thermal simulation tools (DOE-2, TSBI3, TRNSYS and Suncode) are provided.

ADELINE is a collection of MS-DOS programs integrated through a Windows-like, Systems Application Architecture Compliant, graphical user interface. ADELINE encompasses the only official MS-DOS version of the UNIX-based RADIANCE v2.3. Intended program users are researchers, engineers, lighting designers, and architects who have MS-DOS computer literacy and a good understanding of lighting concepts.

ADELINE's lighting analysis process begins with a 3D CAD model of a space created with SCRIBE or converted from DXF. PLINK generates input files for SUPERLITE IEA 2.0 or RADIANCE 2.3pc to calculate interior illuminance levels for simple or complex building spaces. Analysis results can be graphically displayed for predicted electric lighting energy savings. PLINK is also used to model electric lighting system control in response to daylight availability and to generate hourly input files for use with whole-building thermal analysis tools.

Input Required: Geometry associated with surface characteristics by code number in SCRIBE or by layer name in DXF files; appropriate analysis runtime parameters (e.g., geographic location, time of year, sky conditions)

Output Produced: Graphic, on-screen displays of predicted annual and hourly savings; interior illuminance levels; photometrically accurate, color perspective renderings; output of analysis results via ASCII text files for input to spreadsheet for printing.

Supported Platform: IBM-PC compatible computer, 386 or higher with math coprocessor; MS-DOS 3.0 or higher (ADELINE is not a Windows program).

License Cost: $450 US for a site license.

User Support: No telephone support provided; user based, e-mail support facilitated by LBNL through the ADELINE e-mail discussion list. An Internet connection is required to participate in this forum.

NEW FEATURES of ADELINE 2.0

In general, there is improved integration, extended access to program features through a user interface, improved data/information flow among the various programs, merging of SUPERLINK and RADLINK with PLINK provided in the improved SUPERLITE and RADIANCE user interfaces, and a fully SAA-compliant Windows-like graphical user interface. In the documentation, the tutorial has been supplemented and enlarged, on-line help has been extended, and the documentation is now available in HTML format. Specific features and improvements include:

SUPERLITE

- greatly extended modeling limits--SUPERLITE now makes full use of extended memory; limits are 100 surfaces, 20 windows, 20 visual obstructions, 400 nodes
- artificial lighting calculations--import IESNA candlepower distribution data
- simplified input mode--easy-to-use menu oriented input of geometrically simple scenarios for parametric studies at early design stages
- improved graphical input control--overhangs, luminaires and external sunshading devices
- new output plot capabilities and improved functionality
- improved algorithms--adaptive meshing for work surfaces improves accuracy of results

SUPERLINK/RADLINK/PLINK

- new RADLINK program
- link between RADIANCE daylighting calculations and thermal simulation programs
- determine energy and thermal impact of complex daylighting systems in geometrically complex models
- graphical interface to RAD program
- improved integration of utility programs--interface for calculation of sunshine probability files from TRY weather data sets
- new output plot capabilities including SVGA support
- graphic output program has been completely revised including support for a large number of printers and standard graphic formats

RADIANCE

- new 3D-DXF converter dxfconv converts up to AutoCAD R13 files
- obj2rad - converts WAVEFRONT files to RADIANCE scene description
- rlux - calculating illuminances for given view points and directions
- rillum - calculating illuminances at given points
- improved integration through PLINK user interface:
- extended tutorial and adapted it to ADELINE--DOS version
- extended materials database
- additional objects are available: models of furniture, textures
- additional calculation files, candlepower distribution files, and more complex examples

For more Information: Please contact LBNL's Charles Ehrlich at (510) 486-7916 or check the ADELINE World Wide Web site at http://radsite.lbl.gov/adeline/HOME.html where you can download a slide show demo and obtain detailed ordering information including an on-line order form (see next page).

Lawrence Berkeley National Laboratory
1 Cyclotron Rd. MS 90-3111, Berkeley, CA 94720
Phone: (510) 486-7916 FAX: (510) 486-4089
e-mail: ckehrlich@lbl.gov

ADELINE 2.0 ORDER FORM

contract #: L-951172

☐ Yes, I would like to purchase ____ site license(s) of the ADELINE 2.0 software package.

Name, Date:			
Company Name:			
Shipping Address:			
City, State, ZIP:			
Country:			
Correspondence Address (if different):			
Phone, FAX:			
e-mail, media:		check one: ☐ CD-ROM ☐ 6-3.5" disks	

☐ Yes, I would like to participate in the ADELINE e-mail user support list. I understand that this is the only support included with the basic package price.

☐ Yes, I have read and agree to the ADELINE Site License Agreement and a signed copy will be mailed to the address above along with a copy of this completed order form.

☐ Yes, I have written a check or money order payable to "UC Regents" in the amount of $450.00 per site license ($200.00 for upgrade from 1.0), and I have referenced L-951172 on the check.

Mail this form along with your check to:

Lawrence Berkeley National Laboratory
Accounting/Financial Management Dept.
P.O. Box 528
Berkeley, CA 94701
Attn: Shirley A. Tanaka

Total amount enclosed:

LBL Use:	
Date received:	
ckehrlich notified:	
standard 3-day hold:	
date deposited:	

If your institution requires an invoice and purchase order, please mail this completed form to the address at the top of this order form. Any questions may also be directed to Charles Ehrlich at the number above.

The ADELINE 2.0 software package was developed through cooperative research coordinated by the International Energy Agency, Solar Heating and Cooling Task XXI. LBNL acting as an agent of the IEA SH&C provides you with this software pursuant to the IEA SH&C Developers License Agreement.

Attachment A L-95-1172

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9. This Agreement represents the entire understanding of the parties, and supersedes all previous communications, written or oral, relating to the subject of this Agreement.

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By Viviana I. Wolinsky (Please Print)	By _____ (Please Print)
Title Contracts & Licensing Manager	Title_____
Date _____	Date _____

DOE-2 PROGRAM DOCUMENTATION

DOE-2 documentation is available from two sources.

- The National Technical Information Service offers a complete set of DOE-2 manuals, available for purchase separately; prices and ordering information are below.
- The Energy Science Technology Software Center at Oak Ridge, TN, offers the DOE-2.1E updated documentation (which includes the *Supplement, Sample Run Book, and BDL Summary)* free of charge when you purchase the mainframe or workstation version of DOE-2. See the "DOE-2 Directory of Program Related Software and Services" in this issue for ESTSC's address.

Also, many of the PC vendors of DOE-2 offer some or all of the documentation when you buy their program. Names and addresses of all DOE-2 vendors are found in the "DOE-2 Directory of Program Related Software and Services" in this issue.

To order any or all of the DOE-2 manuals from the National Technical Information Service:
National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161
Phone (703) 487-4650, FAX (703) 321-8547, http://www.fedworld.gov/ntis/home.html

Document Name	Order Number	Prices - 4/1/96	Foreign Prices
DOE-2 Basics Manual (2.1E)	DE-940-13165	49.00	
BDL Summary (2.1E)	DE-940-11217	28.00	Double
Sample Run Book (2.1E)	DE-940-11216	100.00	the
Reference Manual (2.1A)	LBL-8706, Rev.2	174.00	prices
Supplement (2.1E)	DE-940-11218	100.00	shown
Engineers Manual (2.1A) [algorithm descriptions]	DE-830-04575	57.00	at left

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