# BUILDING ENERGY SIMULATION

## For Users of EnergyPlus, VisualSPARK, DOE-2, BLAST, Genopt, BDA, ENERGY-10 and their Derivatives

# EnergyPlus Version 1.2.1

## To download a free copy of the program go to

### http://www.energyplus.gov/

● ● *Features of the New Release* ● ●

**Datasets**
- **Default fluid properties for water, ethylene glycol, and propylene glycol**
- **Example input files for all new features (more than 180 example files available)**
- **More than 100 new international weather locations in the EnergyPlus/ESP-r weather format (more than 680 locations worldwide).**

**Geometry/Windows/Walls/Shading**
- **Multi-sided polygons**

**Daylighting**
- **Skylight light wells**
- **Daylighting through interior windows**
- **Translucent Glass**

**Zone Model**
- **Improved displacement ventilation interaction with thermal mass**

**COMIS Air Flow Calculation**
- **Significant decrease in execution time**

**Output**
- **Ventilation load report**
- **Each zone defined as layer in DXF**
- **Advanced runtime variables can be requested**

**HVAC**
- **Plate heat exchanger component added to facilitate realistic configuration of hydronic systems**
- **Two- and four-pipe induction units**
- **Variable-speed fan-powered VAV reheat terminal units**
- **DOE-2.1E electric chiller model**
- **Dual setpoint controls for plant loop for water loop heat pump**
- **New water cooling coil (replaces simple coil) that is completely autosizable, options for wet/dry coil evaluation using cross- or counter-flow heat exchanger configurations**
- **Glycol concentrations can be specified**

**Economics**
- **Utility rate calculations**
- **Project construction cost estimating**

**Utilities**
- **Major updates to the IDFEditor including the ability to open multiple IDF files and copy/paste objects between files**
- **Major updates to EP-Launch including ability to select a group of simulations to run and maintain a history of simulations.**

**Documentation**
- **Input/Output Reference and Engineering Reference updated and extended for all new features and updates.**
- **More than 2,000 pages of documentation**

● ● **And speed improvements throughout** ● ●

# Ask An EnergyPlus Expert

## AIR FLOW, UNITARY SYSTEM

I am using the FURNACE:BLOWTHRU:HEATCOOL unitary system. Can I specify one flow rate for the cooling operation and a different flow rate for the heating operation?  Or can this type of system only be specified at one flow rate?

**Answer**
FURNACE:BLOWTHRU:HEATCOOL operates with a single flow rate for both heating and cooling.  You must model two systems, one for heating and one for cooling, to have different flow rates.  Because a given zone may be served by only one AIR PRIMARY LOOP, the second system must be a piece of zone equipment, such as AIR CONDITIONER:WINDOW:CYCLING or UNIT HEATER.

**Question**
So, if I can't specify two flow rates for this system, is there another unitary system that I can use or do I have to create two separate systems, one for heating and one for cooling?

**Answer**
It depends on what you are trying to learn with your model.  If you have unlimited purchased air capacity and set it to be the first priority, then the entire load will be met by purchased air and the other system will never operate. If you specify the baseboard system as first priority, the purchased air will pick up the remaining load.

## THERMAL MASS

What is the difference between non-thermal mass walls and thermal mass walls in EnergyPlus?
Are thermal mass walls supposed to simulate only furniture?  Also, I can't find an example idf file for the problem I need to solve: namely, I want the external walls to have thermal mass.

**Answer**
Non-thermal mass walls
  are those described with all layers (or only one layer) using "Material:R" materials -- i.e., described only by resistance.  All other walls will have inherent "thermal mass" (i.e., described with L,Cp,K,D characteristics).

Internal Mass
  walls should be described with the normal characteristics  (i.e., L,Cp,K,D) so that the mass of the item(s) do interact with the heat  balance solution.  Internal mass could be used for internal partitions, furniture, or other items that may affect the thermal balance.

Virtually all of the sample files have exterior surfaces described with thermal mass.

## SWITCHABLE GLAZING EXAMPLES

Are there examples of how to model switchable glazing?

**Answer**  Switchable Glazing is used in:

| | |
|---|---|
| DXSys.idf | PSZ.idf |
| DXSysWithHR.idf | PSZDRAWTHROUGH.IDF |
| PurchAirWithDaylighting.idf | |

# Ask An EnergyPlus Expert

## DAYLIGHTING, COORDINATE SYSTEM

I get this warning message a lot:

> "Warning World coordinate system selected. Some building zone..."

Because I use switchable glazing, I have to do the daylighting calculations and need to get rid of this warning.

**Answer**
You can ignore the warning, which is telling you that you selected "world coordinates" in your SurfaceGeometry object but have non-zero origins in the Building and Zone statements.  The Detailed Daylighting model uses these non-zero coordinates as you enter the reference points for the daylighting in "relative (to building/zone origins) coordinates."  The World Coordinate system does not use the building/zone origins at all.

## RADIATION TERMS

I am trying to calculate the total radiation incident that is absorbed on a surface.  The outputs for radiation incident on a surface are sky diffuse, ground diffuse, and solar beam.  However, the absorptance constants for the building material are thermal, solar, and visible.  How do I calculate the fraction of each radiation that is absorbed?

**Answer**
The reported sky diffuse, ground diffuse and beam radiation incident on a surface are all solar quantities. They should be multiplied by the solar absorptance of the surface to get the amount of each that is absorbed.

**Question**
What about the IR heat exchange? The IR heat exchange with the sky can be estimated from the known sky and surface temperature. In the case of the IR heat exchange with the ground, do the ground temperatures from the weather file have to be accounted for? What is the IR emittance coefficient for the ground like in EnergyPlus?

**Answer**
For calculating IR from the ground, the ground is assumed to have an IR emissivity of 0.9 and a surface temperature equal to the outside air temperature. The ground temperatures from the weather file are not used.

The IR from the sky depends on the sky temperature, which is calculated from outside air temperature, atmospheric moisture and cloud cover.

## WATER HEATER TEMPERATURE NODE

I would like to have the "use loop" of a solar heating system plant available whenever the water heater temperature is above the temperature of a node in another circuit.  I am using a "system availability manager:differential thermostat" object but I can't get the value of the water heater temperature node.

**Answer**
Use the "Use Side Outlet Node" of the water heater to get the water heater temperature.

# Ask An EnergyPlus Expert

## HVAC-DIAGRAM

How do I access the HVAC diagram?  I tried looking at it from the EP-Launch window but got the warning "No SVG Browser Selected."  What does this mean and how can I look at the HVAC diagram?  My output said that it was created successfully so I am assuming it is there somewhere.

**Answer**
After you have installed an SVG viewer, then in EP-Launch you must also choose  "Autoselect Programs" from the File menu to set the viewer application in EP-Launch.  You only need to do this once and it will remember the setting. The HVAC-Diagram tool is discussed in the AuxiliaryPrograms document (you have to go through the "enhancing EnergyPlus submenu").  There is a free SVG reading tool from Adobe (http://www.adobe.com/) that you can then tell EP-Launch about and bring it up in the browser. There are probably other SVG readers available.

## WATER BYPASS LOOP

I tried to connect Purchased:Chilled Water to my cooling coil but got an error message that said a PLANT LOOP was needed. I put the Purchased Chilled Water branch onto a PLANT LOOP, then got an error message that said a PUMP was needed! Then I wondered whether CONNECTOR LIST, SPLITTER, MIXER, PIPE, would also be needed? So, for my Purchased:Chilled Water, I would like to know what is needed and what is not.  And do I need to construct a bypass loop ?

**Answer**
For Purchased:Chilled Water and Purchased:Hot water simply replace a chiller or boiler.  You still need a complete plant loop with pump and controls.  See the 5ZoneAuto.idf example file.  You can also use the HVAC template commands "ChillerSupply1WithBypass-Autosize" and  "BoilerSupply1WithBypass-Autosize" to set up your plant loop  description.

If you use a variable speed pump, then you do not need a bypass.  If you use a constant speed pump, then you need a bypass.  It never hurts to include a supply bypass branch even if it is never used.

## HEAT RECOVERY

Why is it necessary to have an outside air mixer in order to use the Air-to-Air Heat Exchanger:Generic? In the system I want to simulate, there is a fan together with a heating coil and a cooling coil in each zone to heat or cool the circulation air. The ventilation air is provided by a separate outdoor air system, in which I would like to have total heat recovery between outside air and relief air. There should not be air mixture between supply air and return air. I am not sure how I can implement this system in EnergyPlus.

**Answer**
The mixing box and its controller are needed to set the flow rate for the outside air stream.  If you set the minimum outside air flow to equal the supply air flow then you will get 100% outside and therefore no mixing as desired.

# Ask An EnergyPlus Expert

## WATER HEATERS

If I use WaterHeater:Simple only for domestic hot water, how do I connect the nodes in the water loop? Since I don't connect the WaterHeater to any coil or equipment, do I make up a dummy hot water loop for my WaterHeater ?

**Answer**
The WaterHeater:Simple object is a multipurpose object that can serve both domestic hot water demands and also serve as a source of heat to a hot water coil loop. The example file is called EnergyPlus\ExampleFiles\Misc\HRGenChill.idf.  Currently, WaterHeater:Simple will not be executed unless it sits on a branch, and the branch will not get executed unless it sits on a  loop.  So, yes, you must make up a dummy hot water loop.

**Question**
If I put the WaterHeater in a zone, say, HouseBasement, EnergyPlus doesn't do heat balance between the tank and the zone air.

**Answer**
No it does not automatically interact with the heat balance.

**Question**
Are there other WaterHeater objects in EnergyPlus that can interact with zone air?

**Answer**
The hot water heater needs to have the standby losses specified by the user for the hot water tank. This loss affects the amount of time the burner has to run to maintain the tank temperature. And the same loss can be input in the building as an additional internal load.

## OUTSIDE BUILDING TEMPERATURE

Can EnergyPlus simulate a building that has a different outside temperature for each floor? The heat rejection from the air conditioners will increase the temperature around building, and I want to factor the increased temperature into the building energy simulation. How sensitively can EnergyPlus simulate for the different outside temperature?  And is there an example?

**Answer**
EnergyPlus is very sensitive to different outside temperatures, although there is no way to specify a different outside temperature for different parts of the building.  However, you might try editing the weather file and then run the entire building at the warmer temperature.  To edit the weather data, use the weather converter to convert your base weather file to csv format, then use a spreadsheet program to alter the outdoor dry bulb temperature, then convert it back to epw format.

For more details on how to manipulate weather files, see page 4 of the *Building Energy Simulation User News Vol. 25, No. 3 (May/June 2004).*

# Ask An EnergyPlus Expert

## SYSTEM SIZING

I am sizing my air loop system which consists of the air to air heat pump (UNITARYSYSTEM: HEATPUMP: AIRTOAIR). I want to size the entire system based upon the cooling coil requirements. Therefore, I want the maximum air flow rate based upon that needed by the cooling system and the cooling coil capacity to be sized strictly on what is necessary for the design cooling load. The current system I have now sizes to meet the heating loads, since the necessary heating maximum design air flow rate is roughly 0.2 m$^3$/s greater then the cooling maximum design air flow rate. Also, the design heat load is roughly 3 kW greater than the design cool load. The remaining heating load that the heat coil cannot satisfy I want to be met with the supplemental heating. What I want to know is how can I manipulate the idf file to size the system based on the cooling requirements? I have already tried to set the cooling capacities and all the air flow rates to that specified to meet just the design cooling load and left the heat capacity and supplemental heating to autosize. When I try to run this, EnergyPlus shuts down without giving me an error message. Can I specify sizes on certain inputs such as the cooling capacity and flow rates but just autosize the heating coil and supplemental heating?

**Answer**
In general, you cannot mix and match autosizing with specified sizes. In the zone sizing object, you can specify design air flow rates for both heating and cooling and let everything else autosize accordingly. See the Input Output Reference explanation for the Zone Sizing object.

## SUB-HOURLY SCHEDULES

Does EnergyPlus have the capability of looking at sub-hourly schedules to investigate the dynamic response of systems to short-duration, high-intensity loads? I would like to investigate the response of different system options and capacities in a waiting area that will see occasional 15-minute periods with very high occupancy (3-5 SF/person) every couple of hours with very low loads in between.

**Answer**
EnergyPlus can do this. The zone/heat balance time-steps go down to 10 minutes. If your sub-hourly schedules don't line up with the time-steps, you can control if the program should interpolate schedule values to them (or not). HVAC system "detailed" time-steps are finer and should show how systems might respond to the impluse. You can also see how zone air temperatures and comfort models are affected.

## CEILING DIFFUSER

Can I specify the location of the ceiling diffuser in a zone? For example, in the center of the zone, near the perimeter area. I want to measure the difference in energy consumption if the diffuser is placed in different locations around the room.

**Answer**
No. The correlations are based on an "office sized room" (9ft W x 9ft H x 15ft L) with a centrally located radial ceiling diffuser and a corner, floor return.

# Ask An EnergyPlus Expert

## SKY MODEL

I took the sky temperatures from the results in EnergyPlus and compared them to the predictions of some models from the literature (Cole's, Clarke's, Czeplak, etc., for the same weather file).  However, none of them matched the results in EnergyPlus.  How does EnergyPlus calculate the sky temperatures; are they taken from the weather files? If yes, how are these temperatures calculated?

**Answer (**From the code)

```
! Determine Sky Temp ==
 ! Function of DryBulb, DewPoint, OpaqueSkyCover
 ! Calculate Sky IR
 !HIR = ESKY * SIGMA * (TOUT**4)
 !
 !where
 !
 !HIR = horizontal IR intensity (W/m2)
 !ESKY = sky emissivity
 !SIGMA = Stefan-Boltzmann constant = 5.6697e-8 W/m2-K4
 !TOUT = drybulb temperature (K)
 !
 !The sky emissivity is given by
 !
 !ESKY = [0.787 + 0.764*ln(TDEW/273)]*[1 + 0.0224*N - 0.0035*(N**2) + 0.00028*(N**3)]
 !
 !where
 !
 !TDEW = dewpoint temperature (K)
 !N = opaque sky cover (tenths)
 !
 !Example: Clear sky (N=0), TOUT = 273+20=293K, TDEW = 273+10=283K:
 !
 !ESKY = 0.787 + 0.764*0.036 = 0.815
 !HIR = 0.815*5.6697e-8*(293**4) = 340.6 W/m^2

 !References:
 !
 !George N. Walton, "Thermal Analysis Research Program Reference Manual,"
 !NBSIR 83-2655, March 1983, p. 21.
 !
 !G. Clark and C. Allen, "The Estimation of Atmospheric Radiation for Clear and
 !Cloudy Skies," Proc. 2nd National Passive Solar Conference (AS/ISES), 1978, pp. 675-678.
```

Also, don't forget that EnergyPlus uses horizontal infrared in units of watts per square meter rather than a sky temperature in Kelvin.

## RADIANT PANELS

I am modeling a radiant cooling slab system with a perimeter radiant panel heating system.  I can't find the "hydraulic radiant panel system" in EnergyPlus.  Should I set the "Radiant Panel" as "Baseboard Heater: Water:Convective"?  And what about other directions?

**Answer:**
You have two options:  Either use Baseboard Heater:Water:Convective which is thermostatically controlled and adds heat to the space by convection  -- or -- use LOW TEMP RADIANT SYSTEM:HYDRONIC with the source near the inside face of the surface and a very thin layer of material on top of it.

# Ask An EnergyPlus Expert

## OUTDOOR DRY BULB TEMPERATURE

I just compared my outdoor dry bulb temperature from the EnergyPlus output to the outdoor dry bulb temperature listed in the weather file and they are not the same.  Is there any reason for this?

**Answer**
This is expected.  The difference comes from interpolating hourly weather data for subhourly time-steps in EnergyPlus.  In an hourly weather file, the temperatures and other state-point readings are the value at the time the reading was taken.  For example, in the USA_IL_Chicago-OHare_TMY2.epw file, the outdoor dry bulb value for July 2, hour 1, is 19.4C.  This is the temperature at 1:00 am.

If you set TIMESTEP IN HOUR = 1, then EnergyPlus will report 19.4C for 07/02  01:00 and will use that value for the entire one hour time-step.

If TIMESTEP IN HOUR = 4, then 19.4C is used only for the time-step that ends at 01:00.  The other time-steps use linearly interpolated values between the hourly weather file values.  When you report at the "hourly" frequency in EnergyPlus, you see the average temperature over the hour.  If you report at the "time-step" frequency, you will see the values from the weather data file appear at the last time-step of each hour.

## TDD:  DIFFUSER VS DOME

There are two choices (out of five in the IDF editor) for surface type called TDD:DIFFUSER and TDD:DOME. Are these choices selectable or can we choose only window, door, or glassdoor?

Also, can the DIFFUSER be used for an inlet vent that would have pre-assigned zero heat transfer and solar properties so the user could assign some airflow properties to it?

**Answer**
The TDD:DIFFUSER and TDD:DOME sub-surfaces are used for constructing Tubular Daylighting Devices (TDD), i.e., tubular skylights. The TDD:DIFFUSER is a diffuser for light, not air flow.

I believe the documentation for this object didn't quite make it into the PDFs in the first few weeks of the release (but it's since been fixed). The updated Input Output Reference and Engineering Reference with a complete description of TDDs can be found at:
http://www.eere.energy.gov/buildings/EnergyPlus/documentation.html

For more information, check out the recent publication  *SIMULATION OF TUBULAR DAYLIGHTING DEVICES AND DAYLIGHTING SHELVES IN ENERGYPLUS*  by Peter G. Ellis (National Renewable Energy Laboratory, Golden, CO), Richard K. Strand and Kurt T. Baumgartner (School of Architecture, University of Illinois at Urbana-Champaign, Champaign, IL) Proc. SimBuild 2004, Building Sustainability and Performance Through Simulation, August 4-6, 2004, Boulder, CO, USA.
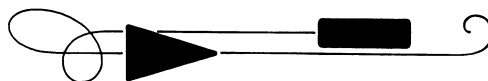
**EP-QUICK**

**Beta Test of EP-Quick  (Beta Test ends November 15!)**
EP-Quick is a simple program that creates an EnergyPlus input file for a building without HVAC. Using simple templates you create the building shape and zone layout. EP-Quick is not a full interface for EnergyPlus but simply a way to generate input files quickly.

The installer may be downloaded from **http://www.glazersoftware.com/download.htm**

To use it, press the "NEW" button and select a template and  the types of floors. Once a template is selected, zoning and shape are fixed but the overall dimension of the building can be changed.  The buildings are "prismatic" and are the same shape and size on all floors.  Windows and doors may be added and constructions and schedules may be modified. zoning and shape are fixed but the overall dimension of the building can be changed.  The buildings are "prismatic" and are the same shape and size on all floors. Windows and doors may be added and constructions and schedules may be modified.

Use main "tree" interface to examine and modify the many different details of the building.  The main parts of the tree are:
- Overall Geometry - depth, width
- Building - roof, floor, interior constructions
- Defaults - default values used in "Floorplans"
- Internal Gain Types - lighting, people, schedules
- Floorplans - zones, exterior walls, windows, etc
- Corners - locations of the building vertices
- Roof corners - locations of special roof vertices

Please take a look at the software and the resulting IDF files. We need your feedback on:
- Bugs
- User Interface
- Capabilities
- Price
- Templates desired

Several bugs were found in the 0.3 release and fixed for this 0.5 release:
- Both IP and SI units are supported but sometimes the SI default values for meters in the 0.3 release were the same  values as the IP default values for feet making them too  large to be reasonable. New defaulting for SI has been included in the 0.5 release. Defaulting for IP is unchanged.
- If multiple doors were described in EP-Quick version 0.3 for the same wall, they were created using the same name which caused an EnergyPlus to indicate a warning. In the 0.5 version this has been fixed.
- If multiple windows were described in EP-Quick 0.3, a warning was issued by EnergyPlus due to the FullInteriorAndExterior solar distribution algorthim being specified.  Now EP-Quick 0.5 chooses the MinimalShadowing  algorithm instead to avoid the warning.
- Not all the building templates would allow tilted roofs in version 0.3. All the templates now support tilted roofs.
- In addition, a problem with roof peak heights that resulted in very shallow roofs (and thus causing a severe error when run in EnergyPlus 1.2) has been fixed.

The beta test will end and the beta version will stop working on November 15 but please send your comments to me ( **jason@glazersoftware.com** ) a soon as possible.

## EnergyPlus    NEW WEATHER FILES

### ● Sri Lanka and the Maldives ●

We are happy to announce the availability of new EnergyPlus-format weather data for 11 locations in Sri Lanka and Maldives. The data are from the Solar and Wind Energy Resource Assessment (SWERA, http://swera.unep.net/ ) project, funded by the United National Environment Programme, Global Environment Facility. Thanks to SWERA for making these data available.  SWERA plans to release similar hourly data for Bangladesh, Brazil, Ethiopia, Ghana, Kenya, and Nepal over the coming months.  We will post that as soon as it becomes available.

This brings the total number of weather files available to 676 with more than 280 in the US, 55 in Canada, and 331 around the world. All the new data are available on the international weather page of the EnergyPlus web site:  http://www.energyplus.gov/cfm/weatherdata_int.cfm

If you know of other typical weather data that could be shared with EnergyPlus users, please contact Dru Crawley or Linda Lawrie directly.  There are another set of 60+ files created for Italy that we plan to post as soon as time allows.

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*The Forecast Looks Favorable for  …*

## *(Free!)  Weather Data on Demand*

**You can access archived weather data from around the world through this U.S. DOE web interface:**

www.eere.energy.gov/buildings/energyplus/cfm/weatherdata/weather_request.cfm

Hourly weather data is continuously collected and stored into a local database, available through this web interface. Most stations have information for dry bulb temperature, wet bulb temperature, wind speed/direction, atmospheric pressure, visibility, cloud conditions, and precipitation type.

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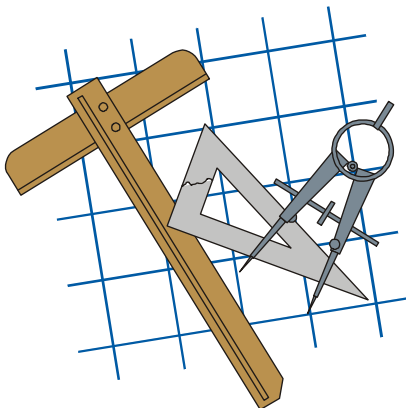
### Building Energy Tools Directory

The web-based Building Energy Tools Directory contains information on more than 270 building-related software tools from around the world.

For each tool in the directory, a short description is provided, along with information about technical expertise required, users, audience, input, output, validation, computer platforms, programming language, strengths, weaknesses, technical contact, availability and cost.  A link is also provided for directly translating the web pages into more than eight languages.

Know of a tool (yours?) that isn't in the directory? Visit http://www.eere.energy.gov/buildings/tools_directory/your_software_here.html or contact Dru Crawley at Drury.Crawley@ee.doe.gov.

# EnergyPlus Version 1.2.1

## To download a free copy of the program go to

## www.energyplus.gov

*EnergyPlus is an  R&D 100 Award Winner, named one of the 100 most technologically significant new products of the year.*

### EnergyPlus Support Tools

Support software is listed on our website (http://SimulationResearch.lbl.gov/EP/ep_tools.html) and in Section 2 of this newsletter.

### EnergyPlus Weather Data from www.energyplus.gov/

There are 275 locations in the United States, 16 California thermal zones, 55 Canadian locations, and 233 international locations in more than 80 countries.

### Ask an EnergyPlus Expert

Questions from EnergyPlus users are answered promptly via email by program developers. To submit questions, join the EnergyPlus User Group at http://groups.yahoo.com/group/EnergyPlus_Support/.
A selection of questions/answers are compiled (yearly) into a downloadable PDF document:
Q and A for 2002, Q and A for 2003.

### EnergyPlus Validation

For reports about testing and validation, go to
http://www.eere.energy.gov/buildings/energyplus/testing.html.

### Are you an EnergyPlus Consultant ?

If you are engaged in EnergyPlus consulting, and would like to be listed in the *Building Energy Simulation User News* and on our website (http://SimulationResearch.lbl.gov), please send details to klellington@lbl.gov.

### Join the EnergyPlus User Group

The developers of EnergyPlus have formed a support group to foster discussion and maintain an archive of information for program Users. We invite questions about program usage and suggestions for improvement to the code. Go to http://groups.yahoo.com/group/EnergyPlus_Support/

### Translate EnergyPlus Web Pages

A new link on the main EnergyPlus web page (www.energyplus.gov/) allows you to view the pages in any of eight languages. Unfortunately, the translator doesn't work with PDF files. Look for the fish at the bottom of the web page. Pages may be translated into Chinese, French, German, Italian, Japanese, Korean, Portuguese and Spanish.

**SPARK** *is an equation-based simulation environment that allows you to build customized models of complex physical processes by connecting calculation objects that represent system components like walls, fans, heat exchangers, chillers, ducts, mixing boxes, controls, etc.  It is aimed at the simulation of innovative and/or complex building systems that are beyond the scope of whole-building programs like DOE-2 and EnergyPlus.* **VisualSPARK** *adds a graphical user interface to SPARK to simplify its use.*

**Download VisualSPARK free of charge from**

# http://simulationresearch.lbl.gov/

**Please go to our website to download new VisualSPARK documentation:**

- **New Features, Bug Fixes, and Changes**
- **Frequently Asked Questions**
- **How To Port Atomic Classes To SPARK 2.*x***
- **Theoretical Speed-Up Using SPARK**

*SPARK was developed by the Simulation Research Group at Lawrence Berkeley National Laboratory and by Ayres Sowell Associates, with Support from the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technologies Program of the U.S. Department of Energy, Program Manager Dru Crawley.*

**GenOpt** **is an optimization program for the minimization of a cost function, such as annual energy use, that is evaluated by an external simulation program.** **GenOpt** **can be used with any simulation program -- such as EnergyPlus, SPARK or DOE-2 -- that has text-based input and output. It also offers an interface for adding custom optimization algorithms to its library.**

*GenOpt* processes discrete independent variables, such as different window constructions, either for optimization problems with mixed discrete and continuous independent variables or for doing parametric studies.  Some simulation programs, such as EnergyPlus, cannot pre-process the independent variables or post-process values that are computed during the simulation. For such situations, *input function objects* and *output function objects* can now be used without having to modify *GenOpt's* source code.

*GenOpt 2.0* **(with documentation) may be downloaded free of charge from**

**http://SimulationResearch.lbl.gov**

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**New EnergyPlus (and DOE-2) Consultant!!**

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**Phone: (510) 207-9649**

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## Ask Uncle Fred a DOE-2 Question

How is the "Floor-Weight" calculated for DOE-2.1E?
**Answer**
If you mean how should one estimate the input for FLOOR-WEIGHT the canonical answer is to sum the weight of the floor, furnishings, and interior walls and divide by the floor area. Do this for each zone. The units are lb/ft$^2$ or kg/m$^2$. However, FLOOR-WEIGHT is a deprecated feature in DOE-2 and we recommend using the custom weighting factor calculation. To trigger this calculation set the FLOOR-WEIGHT = 0.

# Recent Reports

*These reports are available from the Simulation Research Group at Lawrence Berkeley National Laboratory.*

These papers were presented at SimBuild 2004, *Building Sustainability and Performance Through Simulation*, held August 4-6, 2004 in Boulder, Colorado. The titles are active links, ready to download.

- *IFC HVAC Interface To EnergyPlus: A Case Of Expanded Interoperability For Energy Simulation*
- *Flow In An Underfloor Plenum*
- *Variable Heat Recovery In Double Bundle Electric Chillers*
- *Simulation Of Tubular Daylighting Devices And Daylighting Shelves In Energyplus*
- *Improvement Of The ASHRAE Secondary HVAC Toolkit Simple Cooling Coil Model For Simulation*
- *An Extended Model For Under Floor Air Distribution*
- *Specification And Implementation of IFC Based Performance Metrics to Support Building Life Cycle Assessment Of Hybrid Energy Systems*
- *Comparative Analysis Of One-Dimensional Slat-Type Blind Models*
- *Experience Testing EnergyPlus With The ASHRAE 1052-RP Building Fabric Analytical Tests*
- *Resources For Teaching Building Energy Simulation*

Another new title is from Proc. World Renewable Energy Congress VIII and Expo, Denver, Colorado, August 29-September 3, 2004.

- *Photovoltaic and Solar Thermal Modeling with the EnergyPlus Calculation Engine* (NREL/CP-550-36275)
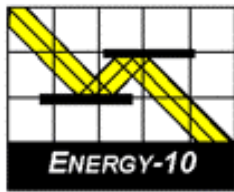
## ENERGY-10,  VERSION 1.6

**ENERGY-10** is a design tool for smaller residential or commercial buildings that are less than 10,000 ft$^2$ or buildings that can be treated as 1- or 2-zone increments. It performs whole-building energy analysis for 8760 hours/year, including dynamic thermal and daylighting calculations. ENERGY-10 was specifically designed to facilitate the evaluation of energy-efficient building features in the very early stages of the design process.

**Douglas K. Schroeder**
**1331 H Street N.W., #1000**
**Washington, DC 20004**

**Tel:  202.628.7400 ext 210**
**Fax: 202.383.5043**
**www.sbicouncil.org**

## Sustainable Buildings Industry Council (SBIC)
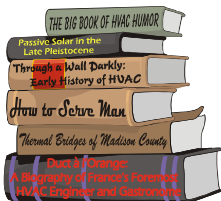
## *Hey!!  Free Book!!!*

The 2004 Buildings Energy Databook is now online. The site has the most up-to-date buildings energy information and is updated regularly. Data can be viewed on-line and complete electronic editions are also available. The Databook contains current buildings-related data and has served as a valuable resource in providing consistent, citable data in a single document.

**http://buildingsdatabook.eere.energy.gov/**

# BLAST*news*

## www.bso.uiuc.edu

**Building Systems Laboratory**
**University of Illinois, 30 Mechanical Engineering Building,**
**1206 West Green Street, Urbana, IL  61801**
**Tel:  (217) 333-3977 - Fax: (217) 244-6534**
**support@blast.bso.uiuc.edu**

The **Building Loads Analysis and System Thermodynamics (BLAST** program predicts energy consumption, energy system performance and cost for new or existing (pre-retrofit) buildings.

BLAST contains three major sub-programs:

- **Space Load Prediction** computes hourly space loads in a building based on weather data and user inputs detailing the building construction and operation.

- **Air Distribution System Simulation** uses the computed space loads, weather data, and user inputs.

- **Central Plant Simulation** computes monthly and annual fuel and electrical power consumption.

**Heat Balance Loads Calculator (HBLC)**
The BLAST graphical interface (HBLC) is a Windows-based interactive program for producing

BLAST input files. You can download a demo version of HBLC (for MS Windows) from the BLAST web site (User manual included).

**HBLC/BLAST Training Courses**
Experience with the HBLC and the BLAST family of programs has shown that new users can benefit  from a session of structured training with the software. The Building Systems Laboratory offers such training courses on an as needed basis typically at our offices in Urbana, Illinois.

**WINLCCID 98**
LCCID (Life Cycle Cost in Design) was developed to perform Life Cycle Cost Analyses (LCCA) for the Department of Defense and their contractors.

**To order BLAST-related products, contact the Building Systems Laboratory at the address above.**

| Program Name | Order Number | Price |
|---|---|---|
| **PC BLAST** Includes: BLAST, HBLC, BTEXT, WIFE, CHILLER, Report Writer, Report Writer File Generator, Comfort Report program, Weather File Reporting Program, Control Profile Macros for Lotus or Symphony, and the Design Week Program. The single CD-ROM includes soft copies of the BLAST Manual, technical articles and theses related to BLAST, nearly 400 processed weather files with a browsing engine, and complete source code for BLAST, HBLC, etc. | 3B486E3-0898 | $1500 |
| **PC BLAST Package**  Upgrade from level 295+ | 4B486E3-0898 | $450 |
| **WINLCCID 98**: executable version for 386/486/Pentium | 3LCC3-0898 | $295 |
| **WINLCCID 98**: update from WINLCCID 97 | 4LCC3-0898 | $195 |
| *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.* | | |

## JOIN THE BLDG-SIM MAILING LIST

BLDG-SIM is a mailing list for users of building energy simulation programs like EnergyPlus, DOE-2, Trace-600, HAP, BLAST, ESP, SERIRES, TRNSYS, TASE, ENERGY-10 and others. Because building simulation professionals  are located  worldwide, the BLDG-SIM list is an attempt to foster the development of a community of those users. Users of all levels of expertise are welcome and are encouraged to share their questions and insights about these programs. To subscribe, send a blank email message to BLDG-SIM-SUBSCRIBE@GARD.COM

The web page for BLDG-SIM is www.gard.com/bldg-sim.htm

Jason Glazer, P.E., of GARD Analytics, Inc., Is the list administrator (jglazer@gard.com).
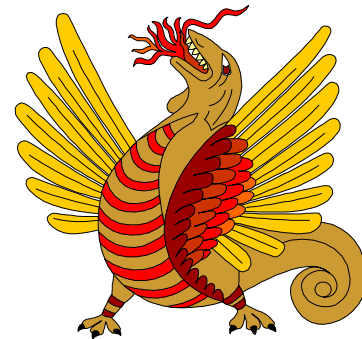
*Run for safety, foolish pedestrians!*

# Building Energy Software

## from the Environmental Energy Technologies Division of Lawrence Berkeley Laboratory

| **Free Downloads** | |
|---|---|
| **BDA 3.0 (Building Design Advisor)**<br>(building decision-making from design through completion) | **gaia.lbl.gov/BDA** |
| **COMIS**<br>(multi-zone air flow and contaminant transport model) | **www-epb.lbl.gov/comis** |
| **EnergyPlus 1.2.1**<br>(new-generation whole-building energy analysis program, based on BLAST and DOE-2) | **www.energyplus.gov/** |
| **GenOpt® 2.0**  (generic optimization program) | **SimulationResearch.lbl.gov** |
| **Optics 5.1.02**<br>(for analyzing optical properties of glazing systems) | **windows.lbl.gov/materials/optics5/** |
| **RADIANCE 3.5**<br>(analysis and visualization of lighting in design)<br>  **Desktop Radiance 2.0β** (integrates the Radiance Synthetic Imaging System with AutoCAD Release 14)<br>  **Radiance Control Panel** (automates some Radiance tasks once the model has been created) | **radsite.lbl.gov/radiance/**<br><br>**radsite.lbl.gov/deskrad/**<br><br>**www.squ1.com/site.html** |
| **THERM 5.2**<br>(models two-dimensional heat-transfer effects in building components where thermal bridges are of concern) | **windows.lbl.gov/software/therm/therm.html** |
| **VisualSPARK 2.0  (Simulation Problem Analysis and Research Kernel)**  (connect component models to simulate innovative building envelope and HVAC systems) | **SimulationResearch.lbl.gov** |
| **WINDOW 5.2**<br>(thermal analysis of window products) | **windows.lbl.gov/software/window/window.html** |
| **Free Software / Request by Fax from  510.486.4089** | |
| **RESFEN 3.1**  (choose energy-efficient, cost-effective windows for a given residential application) | **windows.lbl.gov/software/resfen/resfen.html** |
| **Web Based (free)** | |
| **Home Energy Saver** (quickly computes home energy use)<br>    and<br>**Home Improvement Tool** (simplified Home Energy Saver) | **hes.lbl.gov**<br>    and<br>**hit.lbl.gov** |
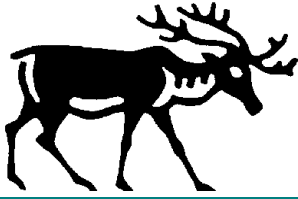
# DOE-2

**DOE-2.1E (v. 121) 1,000-Zone version for Windows from ESTSC; other vendors of DOE-2 based programs are listed on our website: http://SimulationResearch.lbl.gov/.**

Cost is as follows:
- $ 300 U.S. Government/Non-Profits/Education
- $ 575 U.S. Public, Mexico, Canada
- $1129 to $1268 Other Foreign

**DOE-2 Documentation on a CD from ESTSC  -  Cost  US$100**

***What is included on the CD?***

- DOE-2 Reference Manual (Part 1)
- DOE-2 Reference Manual (Part 2)
- DOE-2 Supplement to the Reference Manual (2.1E)
- DOE-2 BDL Summary (2.1E)
- DOE-2 Engineers Manual (2.1A)

**Order Software and ESTSC Documentation**

Ed Kidd or Kim Buckner
NCI Information Systems, Inc.
Energy Science and Technology Software Center (ESTSC)
P.O. Box 1020
Oak Ridge, TN 37831

Phone:  865/576-1037
Fax:       865/576-6436
Email:    estsc@adonis.osti.gov

**Purchase DOE-2 Documentation**

DOE-2 Sample Run Book (2.1E) -- The Sample Run book is the only remaining DOE-2 manual not available electronically. It must be purchased separately from NTIS; ordering information may be found at http://SimulationResearch.lbl.gov > DOE-2 > Documentation

**Free DOE-2 Documentation (http://simulationresearch.lbl.gov/> DOE-2 > Documentation)**

DOE-2 Basics Manual (2.1E)

**Update Packages:**  Update Packages are **not** cumulative; each one contains different information.
Download all four packages then print and insert the pages into your existing DOE-2 manuals.
- Update Package #1:  DOE-2.1E Basics, the Supplement and BDL Summary
- Update Package #2:  BDL Summary and Supplement.
- Update Package #3:  Appendix A of the Supplement.
- Update Package #4:  (1000-zone DOE-2.1E)  BDL Summary.

DOE-2 Modeling Tips (pdf files)   for 2003   for 2002
A compilation of all the "how to" and "DOE-2 Puzzler" articles from the *Building Energy Simulation User News.*

Changes and Bug Fixes to DOE-2.1E (txt file)
Description of all changes and bug fixes in a text document.

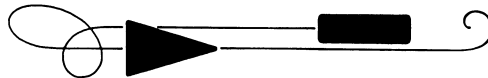## DOE-2 listings are continued on the next page

# DOE-2 (continued)

**DOE-2 Training**

Private or group DOE-2 courses for beginning and advanced users.
Contact Marlin Addison at (602) 968-2040, marlin.addison@doe2.com

**DOE-2 Help Desk**

Email (klellington@lbl.gov) or fax the Simulation Research Group with your questions. Fax: (510) 486-4089

## PG&E Fall 2004 Programs

**Pacific Gas and Electric Company**
**WE DELIVER ENERGY.**

*To register call 415.973.7268 or go to www.pge.com/pec*

| | HVAC |
|---|---|
| November 10 | **2005 Title 24 Nonresidential Mechanical Requirements** |
| November 23 | **2005 Title 24 Nonresidential Mechanical Acceptance Tests** |
| December 06 | **Boilers** |
| | **WHOLE-BUILDING PERFORMANCE** |
| November 16 | **Commissioning Persistence** |
| December 09 | **Commissioning with Data Loggers** |
| | **LIGHTING** |
| November 04 | **Concepts in Photometry and Colorimetry** |
| November 04 | **Kevin Houser: The Trichromatic Nature of Vision** |
| November 23 | **Willard Warren: How Energy Efficiency Drives Lighting Codes and Standards** |
| November 04 | **Kevin Houser: The Trichromatic Nature of Vision** |
| | **ARCHITECTURE AND INTEGRATED DESIGN** |
| November 03 | **High Performance Schools (CHPS) Workshop** |
| November 09 | **Creating Usable Buildings Through Post-Occupancy Evaluation** |
| December 01 | **Managing the Costs of Green Buildings** |
| | **RENEWABLES** |
| November 01 | **Combined Heat and Power (CHP) Applications for Commercial Buildings** |
| November 02 | **Fuel Cells for Commercial Buildings** |
| December 02 | **Solar Hot Water Systems for Commercial Applications** |

## Sacramento Municipal Utility District

### Fall 2004 Educational Classes

**SMUD**
SACRAMENTO MUNICIPAL UTILITY DISTRICT
The Power To Do More.®

*HTTP://WWW.SMUD.ORG*

| November 04<br>8:30 a.m. – 12:00 p.m. | Museum Lighting<br>    Contact:  Connie Buchanan |
|---|---|
| November 09<br>8:00 a.m. – 12:00 p.m. | Title 24 2005 - Nonresidential HVAC Measures<br>    Contact:  Thomas Dean |
| November 17<br>8:00 a.m. – 2:00 p.m. | Title 24 - Preview of 2005 Changes<br>    Contact:  Jodi Newman |

**Classes held at SMUD's Customer Service Center, 6301 "S" Street, Sacramento, California**

# It's The Big Fall Football Maze
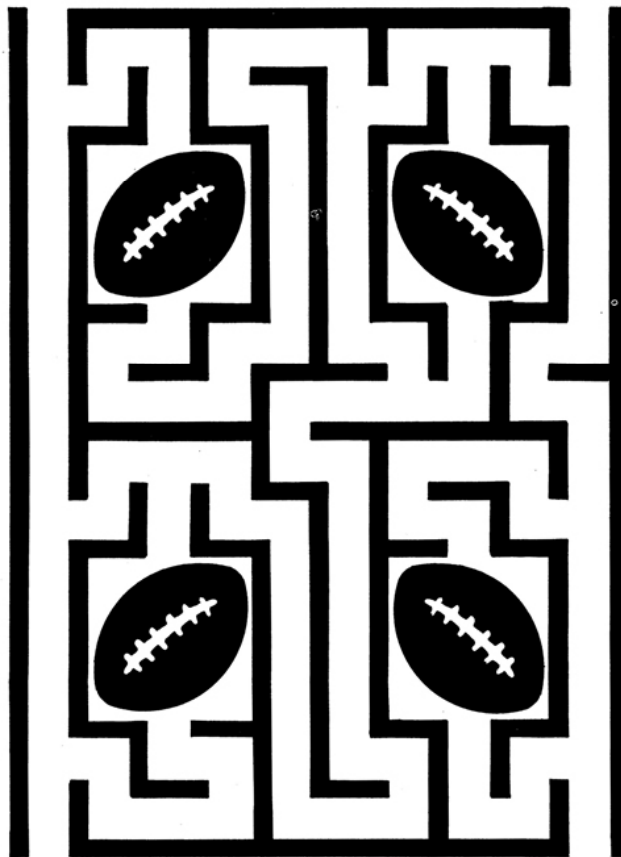


**FOOTBALL**
Enter the maze, pass through all footballs, then exit the maze
without using any path more than once.

**For the solution, see the last page of Section 2 of this newsletter**