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Report on High Performance Building's Energy Modeling

Physical Building Information Modeling for Solar Building Design and Simulation

Jose Luis Bermudez Alcocer
Jeff S. Haberl, Ph.D., P.E.

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Authors: Jose Luis Bermudez Alcocer, Ph.D. student, Texas A&M University

Dr. Wei Yan, PI, Department of Architecture, Texas A&M University

Dr. Jeff Haberl, Co-PI, Department of Architecture, Texas A&M University

Dr. Mark Clayton, Co-PI, Department of Architecture, Texas A&M University

Jon Bum Kim, Ph.D. student, Texas A&M University

Sandeep Kota, Ph.D. student, Texas A&M University

WoonSeong Jeong, Ph.D. student, Texas A&M University

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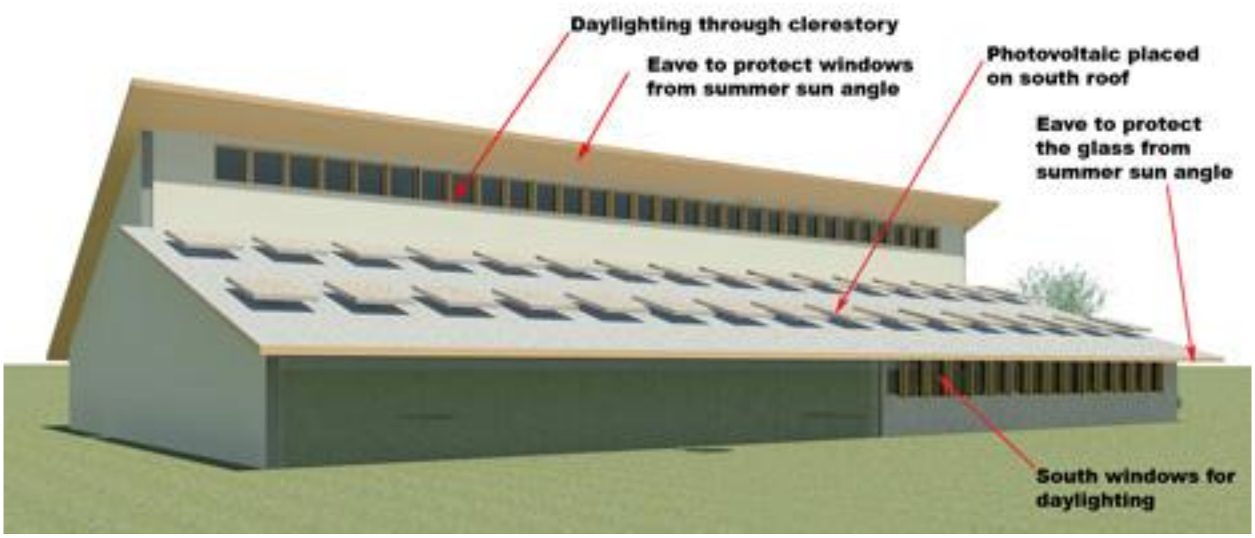
EXECUTIVE SUMMARY

This report was created for the National Science Foundation-Physical Building Information Modeling (NSF-PBIM) project. This report describes the analysis of a solar office building using the following software: the legacy tools (DOE 2.1e, the F-Chart and the PV-F Chart) for whole-building energy analysis, solar thermal analysis and solar electric analysis; the Revit software that was used to render the images of the solar office building and get feedback for the DOE-2.1e; and the Inverse Model Toolkit (IMT) program to transfer data between the legacy tools during the first two years of the National Science Foundation Physical Building Information Modeling (NSF PBIM) project at Texas A&M University.

The results show that the high performance solar office building reduced annual energy consumption by 100 (i.e., Net Zero) percent in both Houston and Denver as compared to a regular office building. In other words, the Net-Zero Energy Office Building which was designed with legacy tools, produces as much as or more energy than it consumes. The solar office building used different renewable energy systems, such as a solar Domestic Hot Water (DHW) system, clerestory windows, daylighting sensors and photovoltaic panels to achieve the Net-Zero Energy Building level.



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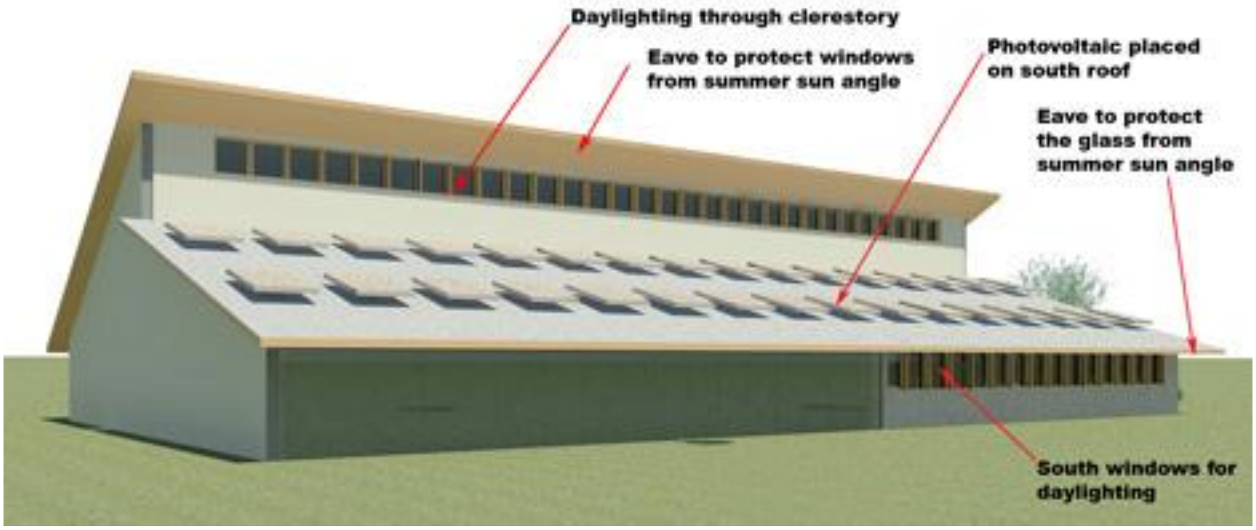
1 INTRODUCTION

The College of Architecture at Texas A&M University received a grant from the National Science Foundation to study physical building information modeling Physical Building Information Modeling (PBIM). During the first two years of the project (National Science Foundation-Physical Building Information Modeling, or NSF-PBIM) several programs were used to analyze a near Net-Zero Energy Building. The analysis was carried out by the DOE-2.1e, F-Chart, PV F-Chart, Revit and Inverse Model Toolkit (IMT) programs. Each software program was reviewed for its relevancy to the project, and a base case for a building in both Houston and Denver was established. The energy savings for each base case was then calculated by running the different software.



2 PURPOSE OF REPORT

The objectives of this report are as follows:

1) Generate a first Revit BIM-model of a complex building for later phases of the research process.
2) Validate results from Loads Report from the DOE-2.1e with hand calculations.
3) Show how a building is simulated and how energy is saved through the use of existing simulation tools as DOE-2.1e, and the use and input of some results from this software into the F-Chart and the PV F-Chart programs.
4) Show a solar thermal simulation of a complex office building, through features such as solar domestic hot water; and passive thermal systems for space heating through south windows, double pane windows and clerestory, with the DOE-2.1e program.

2.1 Legacy Software Used in Report

The literature reviewed is the following: reports about DOE-2.1e (Building Energy Summary, 2002; Cho, 2009; Haberl and Cho, 2004a; Malhotra, 2009; US DOE, 1980a; US DOE, 1980b; Winkelmann et al., 1993); reports about IMT (Kissock et al., 2001); reports about F-Chart (Duffie and Beckman, 2006; Haberl and Cho, 2004b; Klein and Beckman, 2001b); and reports about PV F-Chart (Duffie and Beckman, 2006; Haberl and Cho, 2004c; Klein and Beckman, 2001b).

2.1.1 DOE-2.1.e

The original DOE-2 was released by the Lawrence Berkeley Laboratory by 1978 (Malhotra, 2009, p.34). We used the latest version, the DOE-2.1e, for this phase of our research. The computer language used to develop DOE-2 was FORTRAN (US DOE, 2010). The DOE-2.1e, as well as BLAST, is an hourly fixed schematic simulation, and a whole energy simulation program as TRNSYS and EnergyPlus. The DOE-2.1e allows architects and engineers to calculate energy consumption in buildings. The structure of the input code is formed by four simulation subprograms. These four subprograms are named as Loads, Systems, Plant and Economics are executed in sequence through the input code. The output is built by the Loads, Systems, Plant and Economics Reports. The software needs binary weather files for weather data calculations. These are usually TMY2 files. We used the Houston and Denver TMY2 weather files for the simulation. The binary files used for Houston were *houstontmy2* and Boulder (*bouldeco)* was used for the Denver simulations. DOE-2.1e uses BDL Processor software to transform the input file into a basic 3D-Model. BDL Processor allowed us to visualize the building from early stages.

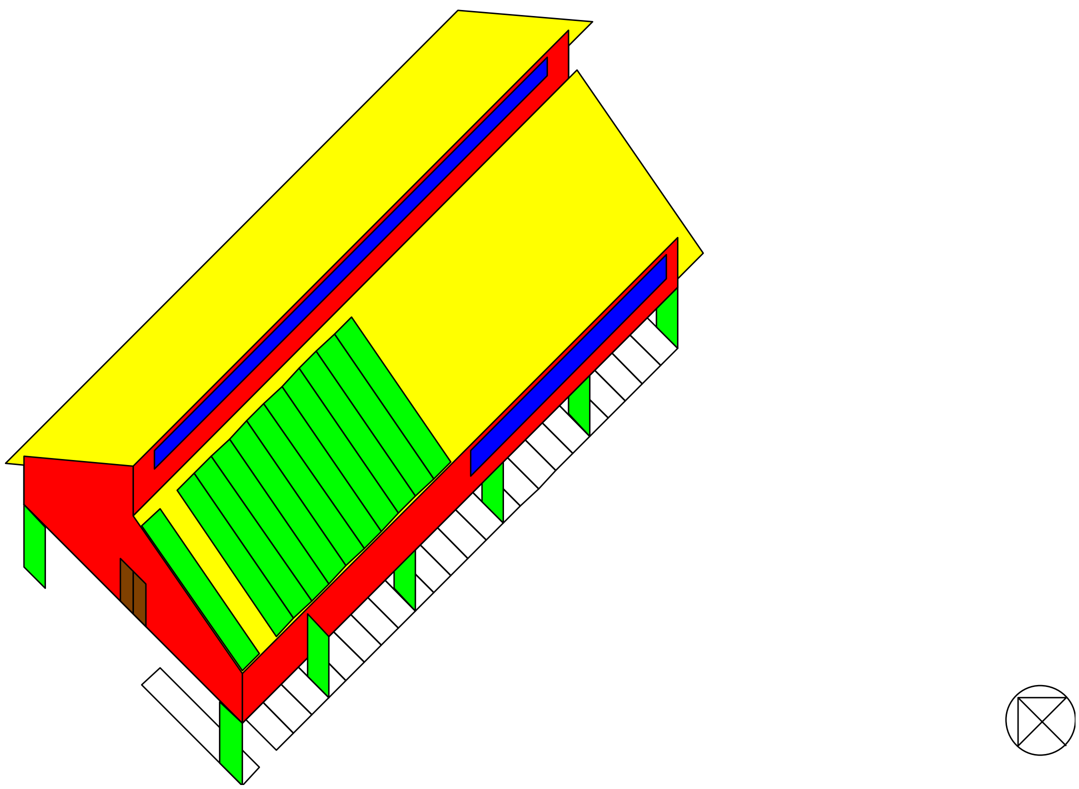


Figure 1: NSF-PBIM Solar Office Building with underground parking spaces simulated with DOE-2.1e software and visualized through DrawBDL Processor.

The proposed office building has a north-south orientation. The building envelope has floor, walls and tilted roofs. It was lifted 10 ft. in the air to avoid the heat transfer with the ground and accommodate a parking lot. The next features were simulated for both climates in order to save energy and achieve near Net-Zero Energy consumption: passive solar, daylighting saving controls, solar thermal energy (domestic hot water) and solar electric energy (photovoltaic). Figure 2 shows the office building with all the used features (southern and northern windows, clerestory, daylighting sensors, domestic hot water and photovoltaic).

The DOE-2.1 uses DOS files that are run to a DOE-2 application. These are the applications:
DOE-2.1e applications:

- shortcut_DOE2_console: It runs the simulation.
- BDL Processor (subprogram): It transforms the input file into a basic 3D-Model.

File formats:

- .inp: input file
- .log: log file
- .out: output file

Modeling process:

- The user creates the input (.inp) file writing down the building description, loads, system, plant and economics.
- The shortcut_DOE2_console is open and the next line command is typed: “doe21e”, “name of the file” and “weather data file”
- The output (.out) file is produced after the simulation is over.
- The building can be visualized with the input (.inp) file through the BDL Processor.

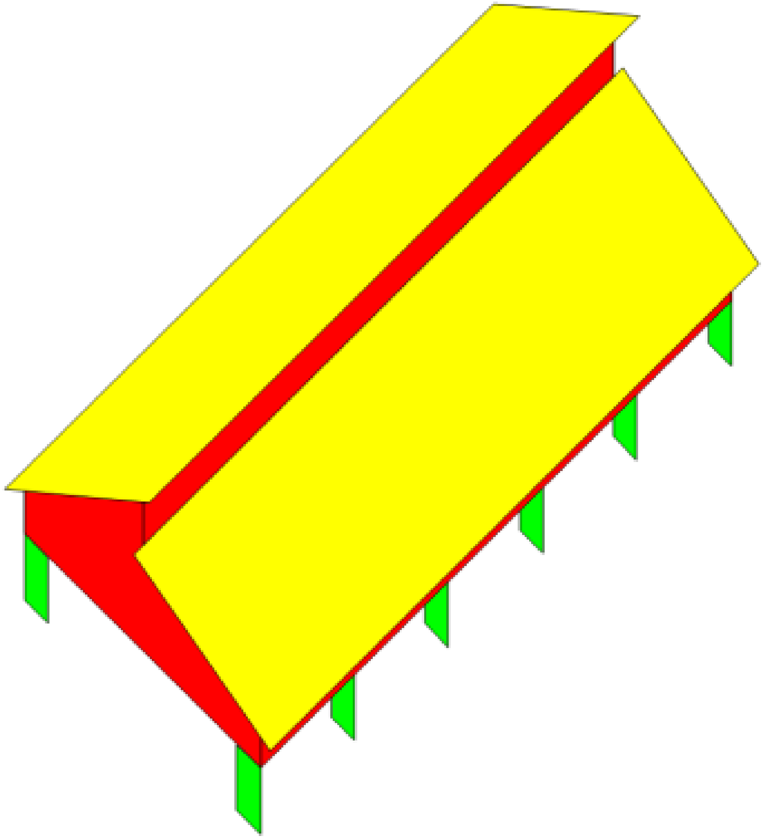


Figure 2: Base case of the Complex Office Building with DrawBDL Processor

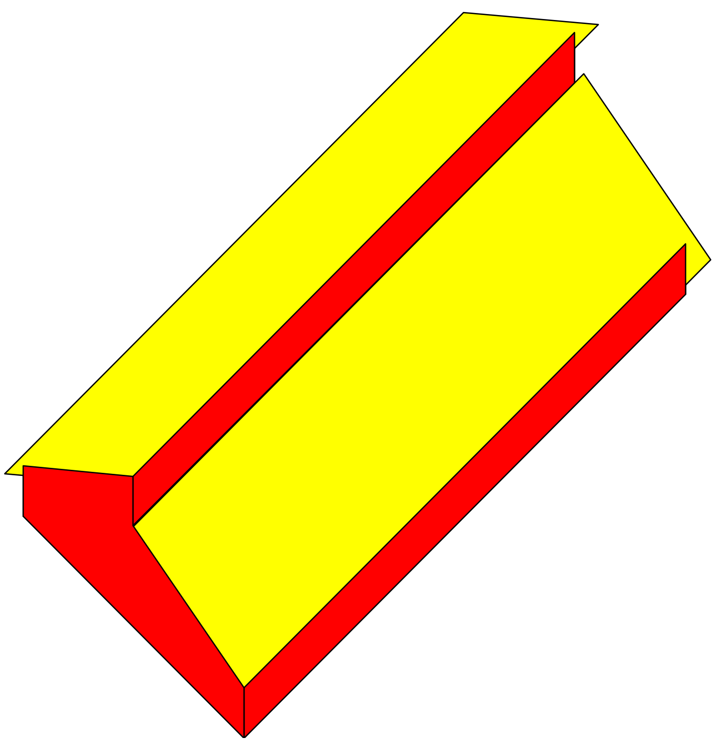


Figure 3: Base case of the Complex Office Building with DrawBDL Processor

2.1.2 Inverse Model Toolkit (IMT)

The ASHRAE's Inverse Model Toolkit (Cho and Haberl, 2004) is a Fortran 90 application used to calculate the linear, change-point linear, variable-based degree-day, multi-linear and combined regression models. The IMT was sponsored by the ASHRAE research project RP-1050 under the guide of the Technical Committee 4.7, Energy Calculations. The IMT was used in order to calculate the heat loss coefficient (Building UA) that needs to be input in the F-Chart software.

2.1.3 F-Chart

Researchers at the University of Wisconsin Solar Laboratory developed a program for the analysis and design of solar thermal systems: the F-Chart (Klein and Beckman, 2001a, p.1). The f-chart method that is used in this software provides an estimated fraction of a total heating load that will be supplied by solar energy for a given system (Duffie and Beckman, 2006, p.673). The program can estimate the performance of an array of features such as: domestic water heating systems, pebble bed storage space and domestic water heating systems, water storage space and domestic water heating systems, active collection with building storage space heating systems, direct-gain passive systems, collector storage wall passive systems, pool heating systems, general solar heating systems and integral collector-storage domestic water heating systems. We analyzed a feature for the complex building for Houston and Denver: an active solar collection with building storage (DHW). The weather data was supplied by the California Energy Commission.

The following are the F-Chart applications, files generated and the modeling process:

F-Chart applications:

- It does not have any additional applications.

File formats:

- .FC: output files

Modeling process:

- The user selects the system, type of collector, weather and economic parametric, and fills down each window with the information.
- The user runs the calculation and obtains two windows: thermal output and economic output.
- The file can be save as *.FC with all the data input.

2.1.4 PV F-CHART

For this analysis the PV F software used was developed by researchers at the University of Wisconsin Solar Laboratory. This program was intended for the design and economic analysis of photovoltaic systems (Klein and Beckman, 2001b, p.1). The PV f-chart method that is used in this software consists of a combination of correlations for the hourly calculations of solar radiation at a certain place (Malhotra, 2009, p.36). The program can estimate the performance of an array of features such as: utility interface systems, battery storage systems and systems with no interface or battery storage. We analyzed a photovoltaic system for the complex building for Houston and Denver. The weather data was supplied by the California Energy Commission.

The following are the PV F-Chart applications, files generated and the modeling process:

PV F-Chart applications:

- It does not have any additional applications.

File formats:

- .PVF: output files

Modeling process:

- The user selects the system, weather and economic parametric, and fills down each window with the information.
- The user runs the calculation and obtains two windows: system performance and economic results.
- The file can be save as *.PVF with all the data input.
-

2.1.5 Revit BIM

Revit is a software program that uses a platform involved in architecture, structural engineering and mechanical engineering, and uses parametric design in order to achieve the tasks in each field (Dzambazova et al., 2009, p.10). The Building Information Modeling (BIM) is an application that targets problems from industry: communication, coordination and change management. It also provides the following possibilities: the projects are ready to go directly to fabrication, digital shop drawing submittals, and 4D construction planning (Dzambazova et al., 2009, p.10).

3 ANALYSIS OF THE NEAR NET-ZERO ENERGY SMALL SOLAR OFFICE BUILDING

The analysis of the near Net-Zero Energy small building simulation will involve the next steps:

- Background of the near net-zero small near Net-Zero Energy small solar office building;
- Analysis through DOE-2.1e;
- Analysis through the Inverse Model Toolkit (IMT);
- Analysis through F-Chart;
- Analysis through PV F-Chart; and
- Visualization of the Revit BIM Model.

3.1 Background of the Near Net-Zero Energy Small Solar Office Building

The analysis for this period consisted in simulating the complex office building in DOE-2.1e, F-Chart and PV F-Chart for Houston and Denver. The office building was lifted 10 feet in the air to avoid the heat transfer with the ground. Also, this was meant to represent a building with parking underneath. The building envelope consists of walls, roof and floor. Table 1 is the description of the near Net Zero small office building.

Table 1: Solar Office Building Schedule

Location	Houston, TX (29° Latitude, 95° Longitude, 108 ft. Altitude)	Denver, CO (39° Latitude, 104° Longitude, 5,413 ft. Altitude)
Weather data file used for simulation	houstontmy2	Bouldeco
Building floor plan	50 ft. X 100 ft.	50 ft. X 100 ft.
Building orientation	North-south	North-south
Area of the building	5,000 ft^2	5,000 ft^2
Volume of the building	70,000 ft^3	70,000 ft^3
Spaces used for building simulation	1	1
Wall construction (from outside to inside)		
Air layer	0.5 in.	0.5 in.
Brick	4 in.	4 in.
Plastic-film		
Plywood	0.5 in.	0.5 in.
Batt insulation	4 in. (R-11)	6 in. (R-19)
Gypsum	0.5 in.	0.5 in.
Air layer	0.5 in.	0.5 in.
Roof construction (from outside to inside)		
Roof gravel	0.5 in.	0.5 in.
Built up Roofing Material	0.4 in.	0.4 in.
Polystyrene	5 in.	5 in.
Soft Wood	0.75 in.	0.75 in.
Height of the front and back walls	8 ft.	8 ft.
Tilt of the roofs		
South roof	17.79°	17.79°
North roof	32.62°	32.62°
Total surface of walls	3,800 ft^2	3,800 ft^2
Total surface of roofs	6,940.96 ft^2	6,940.96 ft^2
System	VAV (Variable-Air-Volume)	VAV (Variable-Air-Volume)
Cooling	78°F	78°F
Heating	68°F	68°F
Design degree days		
Summer	August 9th	August 25th
Winter	January 14th	February 3rd

Table 2 is the list of simulations for the near net zero building in Houston. Table 3 is the list of simulations for the near net zero building in Denver. The two tables were created during the first year of the NSF-PBIM project. Each table has a matrix with the files developed and analyzed for Houston and Denver. The analysis was done with the DOE-2.1e software. Six manual calculations were done in order to calibrate the model.

The matrix is made up of nine steps:

- **Step One** – Simulations were run from the files 01A1a_0aH and 01A2a_0aD until 01A1a_8aH and 01A2a_8aD.
- **Step Two**:-Cross check of energy analysis simulations vs. manual calculations.
- **Step Three**: First manual calculation after simulating the files 01A1a_0aH and 01A2a_0aD. The first manual calculation is a cross check to verify if the U-Values in the simulation file meet or exceed the values of the code compliance *ASHRAE Standard 90.1-2007 Energy Standard for Buildings except Low-Rise Residential Buildings IP Edition.*
- **Step Four** –The second manual calculation compares the result of the steady-state "q" U-Value and the heating results for the LS-C Building Peak Load component report from the 01A1a_0aH file for Houston and the 01A2a_0aD for Denver.
- **Step Five** – The third manual calculation tested the sensitivity of the size of the floor compared to the overall peak load. The analysis involved the comparison of the heating results from the LS-C Building Peak Load component between the basecase and several case files for Houston and Denver: 01A1a_1caH and 01A2a_1caD, 01A1a_1daH and 01A2a_1daD, 01A1a_1eaH and 01A2a_1eaD, and 01A1a_1faH and 01A2a_1faD, for Houston and Denver respectively. This will compare heating results (base case vs. Houston/Denver).
- **Step Six** – The fourth manual calculation is for a building with insulated floor in both Houston and Denver. The file 01A1a_2aH is for Houston and the file 01A2a_2aD is for Denver.
- **Step Seven** – The fifth manual calculation shows the added south façade fenestration to the files 01A1a_4aH and 01A2a_4aD:
- **Step Eight** – The sixth manual calculation shows the added total façade fenestration to the files 01A1a_8aH and 01A2a_8aD.
- **Step Nine** – Run simulations from 01A1a_9aH and 01A2a_9aD until 01A1a_19aH and 01A2a_19aD.

This is the matrix used for the files for both Houston and Denver in Table 2 and Table 3:

- Column 1 is ID Name given to the file.
- Column 2 is the File Name assigned to each one of the files simulated through DOE-2.1e.
- Column 3 is called PBIM Folder (Folder Localization). It shows the features that were simulated during the analysis process.
- Columns 4 through 24 have each one of the features that were simulated during the analysis process.

Table 2: PBIM Complex Office Building Matrix for Houston

ID NAME	FILE NAME	PBIM FOLDER (FOLDER LOCALIZATION)	HOUSTON, TX	DESIGN DAYS	BUILDING OVER THE SITE	BUILDING LIFT 10 ft.	FLOOR	OCCUPANCY SCHEDULE	LIGHTING SCHEDULE	EQUIPMENT SCHEDULE	INFILTRATION	SYSTEM-TYPE: SUM	SYSTEM-TYPE: VAVS	PLANT	PEOPLE	SOUTH WINDOW	NORTH WINDOWS	DOORS	CLERESTOREY	TROMBE WALL	SOLAR THERMAL	DAYLIGHTING SENSORS	PHOTOVOLTAIC
CASE 0aH	01A1a_0aH	VAVS	X	X		X							X										
CASE 1aH	01A1a_1aH	VAVS (FLOOR = WALL)	X	X		X	X						X										
CASE 1baH	01A1a_1baH	VAVS (HEAVY CONCRETE SLAB ONLY (25' X 50'))	X	X		X	X						X										
CASE 1caH	01A1a_1caH	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 50'))	X	X		X	X						X										
CASE 1daH	01A1a_1daH	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 100'))	X	X		X	X						X										
CASE 1eaH	01A1a_1eaH	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 150'))	X	X		X	X						X										
CASE 1faH	01A1a_1faH	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 200'))	X	X		X	X						X										
CASE 1gaH	01A1a_1gaH	VAVS (HEAVY CONCRETE SLAB (50' X 100') + 4" POLYSTYRENE)	X	X		X	X						X										
CASE 1haH	01A1a_1haH	VAVS (HEAVY CONCRETE SLAB (50' X 100') + 20" POLYSTYRENE)	X	X		X	X						X										
CASE 2H	01A1a_2H	SUM + Plant	X	X	X		X			X		X		X									
CASE 2aH	01A1a_2aH	VAVS + Plant	X	X	X		X			X			X	X									
CASE 3H	01A1a_3H	SUM + Plant + Trombe wall	X	X		X	X			X		X		X						X			
CASE 3aH	01A1a_3aH	VAVS + Plant + Trombe wall	X	X		X	X			X			X	X						X			
CASE 4H	01A1a_4H	SUM + Plant + South window	X	X		X	X			X		X		X		X							
CASE 4aH	01A1a_4aH	VAVS + Plant + South window	X	X		X	X			X			X	X		X							
CASE 5H	01A1a_5H	SUM + Plant + North windows	X	X		X	X			X		X		X			X						
CASE 5aH	01A1a_5aH	VAVS + Plant + North windows	X	X		X	X			X			X	X			X						
CASE 6H	01A1a_6H	SUM + Plant + Clerestory	X	X		X	X			X		X		X					X				
CASE 6aH	01A1a_6aH	VAVS + Plant + Clerestory	X	X		X	X			X			X	X					X				
CASE 7H	01A1a_7H	SUM + Plant + South window + Clerestory	X	X		X	X			X		X		X		X			X				
CASE 7aH	01A1a_7aH	VAVS + Plant + South window + Clerestory	X	X		X	X			X			X	X		X			X				
CASE 8H	01A1a_8H	VAVS + Plant + South window + north windows + Clerestory	X	X		X	X			X		X		X		X	X		X				
CASE 8aH	01A1a_8aH	VAVS + Plant + South window + north windows + Clerestory	X	X		X	X			X			X	X		X	X		X				
CASE 9H	01A1a_9H	SUM + Plant + Trombe wall + South window + Clerestory	X	X		X	X			X		X		X		X	X		X	X			
CASE 9aH	01A1a_9aH	VAVS + Plant + Trombe wall + South window + Clerestory	X	X		X	X			X			X	X		X	X		X	X			
CASE 10H	01A1a_10H	SUM + Plant + Trombe wall + South window + north windows + Clerestory	X	X		X	X			X		X		X		X	X			X			
CASE 10aH	01A1a_10aH	VAVS + Plant + Trombe wall + South window + north windows + Clerestory	X	X		X	X			X			X	X		X	X			X			
CASE 11H	01A1a_11H	SUM + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory	X	X		X	X	X		X		X		X	X	X	X		X	X			
CASE 11aH	01A1a_11aH	VAVS + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory	X	X		X	X	X		X			X	X	X	X	X		X	X			
CASE 12H	01A1a_12H	SUM + People + Occupancy sched + South window + north windows + Clerestory + DHW	X	X		X	X	X		X		X		X	X	X	X		X		X		
CASE 12aH	01A1a_12aH	VAVS + People + Occupancy sched + South window + north windows + Clerestory + DHW	X	X		X	X	X		X			X	X	X	X	X		X		X		
CASE 13H	01A1a_13H	SUM + South window + north windows + Clerestory + DHW	X	X		X	X			X		X		X		X	X		X		X		
CASE 13aH	01A1a_13aH	VAVS + South window + north windows + Clerestory + DHW	X	X		X	X			X			X	X		X	X		X		X		
CASE 14H	01A1a_14H	SUM + Plant + South window + north windows + Clerestory + Daylighting sensors	X	X		X	X			X		X		X		X	X		X			X	X
CASE 14aH	01A1a_14aH	VAVS + Plant + South window + north windows + Clerestory + Daylighting sensors	X	X		X	X			X			X	X		X	X		X			X	X
CASE 15H	01A1a_15H	SUM + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory + doors	X	X		X	X	X		X		X		X	X	X	X	X	X	X			
CASE 15aH	01A1a_15aH	VAVS + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory + doors	X	X		X	X	X		X			X	X	X	X	X	X	X	X			
CASE 16H	01A1a_16H	SUM + DHW	X	X		X	X			X		X		X							X		
CASE 16aH	01A1a_16aH	VAVS + DHW	X	X		X	X			X			X	X							X		
CASE 17H	01A1a_17H	SUM + Photovoltaic	X	X		X	X			X		X		X									X
CASE 17aH	01A1a_17aH	VAVS + Photovoltaic	X	X		X	X			X			X	X									X
CASE 18H	01A1a_18H	SUM + Plant + Doors	X	X		X	X			X		X		X				X					
CASE 18aH	01A1a_18aH	VAVS + Plant + Doors	X	X		X	X			X			X	X				X					
CASE 19H	01A1a_19H	SUM (All features)	X	X		X	X			X		X		X	X	X	X	X	X	X	X	X	X
CASE 19aH	01A1a_19aH	VAVS (All features)	X	X		X	X			X			X	X	X	X	X	X	X	X	X	X	X

Table 3: PBIM Complex Office Building Matrix for Denver

ID NAME	FILE NAME	PBIM FOLDER (FOLDER LOCALIZATION)	DENVER, CO.	DESIGN DAYS	BUILDING OVER THE SITE	BUILDING LIFT 10 ft.	FLOOR	OCCUPANCY SCHEDULE	LIGHTING SCHEDULE	EQUIPMENT SCHEDULE	INFILTRATION	SYSTEM-TYPE: SUM	SYSTEM-TYPE: VAVS	PLANT	PEOPLE	SOUTH WINDOW	NORTH WINDOWS	DOORS	CLERESTOREY	TROMBE WALL	SOLAR THERMAL	DAYLIGHTING SENSORS	PHOTOVOLTAIC
CASE 0aD	01A2a_0aD	VAVS	X	X		X							X										
CASE 1aD	01A2a_1aD	VAVS (FLOOR = WALL)	X	X		X	X						X										
CASE 1baD	01A2a_1baD	VAVS (HEAVY CONCRETE SLAB ONLY (25' X 50'))	X	X		X	X						X										
CASE 1caD	01A2a_1caD	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 50'))	X	X		X	X						X										
CASE 1daD	01A2a_1daD	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 100'))	X	X		X	X						X										
CASE 1eaD	01A2a_1eaD	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 150'))	X	X		X	X						X										
CASE 1faD	01A2a_1faD	VAVS (HEAVY CONCRETE SLAB ONLY (50' X 200'))	X	X		X	X						X										
CASE 1gaD	01A2a_1gaD	VAVS (HEAVY CONCRETE SLAB (50' X 100') + 4" POLYSTYRENE)	X	X		X	X						X										
CASE 1haD	01A2a_1haD	VAVS (HEAVY CONCRETE SLAB (50' X 100') + 20" POLYSTYRENE)	X	X		X	X						X										
CASE 2D	01A2a_2D	SUM + Plant	X	X	X		X			X		X		X									
CASE 2aD	01A2a_2aD	VAVS + Plant	X	X	X		X			X			X	X									
CASE 3D	01A2a_3D	SUM + Plant + Trombe wall	X	X		X	X			X		X		X						X			
CASE 3aD	01A2a_3aD	VAVS + Plant + Trombe wall	X	X		X	X			X			X	X						X			
CASE 4D	01A2a_4D	SUM + Plant + South window	X	X		X	X			X		X		X		X							
CASE 4aD	01A2a_4aD	VAVS + Plant + South window	X	X		X	X			X			X	X		X							
CASE 5D	01A2a_5D	SUM + Plant + North windows	X	X		X	X			X		X		X			X						
CASE 5aD	01A2a_5aD	VAVS + Plant + North windows	X	X		X	X			X			X	X			X						
CASE 6D	01A2a_6D	SUM + Plant + Clerestory	X	X		X	X			X		X		X					X				
CASE 6aD	01A2a_6aD	VAVS + Plant + Clerestory	X	X		X	X			X			X	X					X				
CASE 7D	01A2a_7D	SUM + Plant + South window + Clerestory	X	X		X	X			X		X		X		X			X				
CASE 7aD	01A2a_7aD	VAVS + Plant + South window + Clerestory	X	X		X	X			X			X	X		X			X				
CASE 8D	01A2a_8D	VAVS + Plant + South window + north windows + Clerestory	X	X		X	X			X		X		X		X	X		X				
CASE 8aD	01A2a_8aD	VAVS + Plant + South window + north windows + Clerestory	X	X		X	X			X			X	X		X	X		X				
CASE 9D	01A2a_9D	SUM + Plant + Trombe wall + South window + Clerestory	X	X		X	X			X		X		X		X	X		X	X			
CASE 9aD	01A2a_9aD	VAVS + Plant + Trombe wall + South window + Clerestory	X	X		X	X			X			X	X		X	X		X	X			
CASE 10D	01A2a_10D	SUM + Plant + Trombe wall + South window + north windows + Clerestory	X	X		X	X			X		X		X		X	X			X			
CASE 10aD	01A2a_10aD	VAVS + Plant + Trombe wall + South window + north windows + Clerestory	X	X		X	X			X			X	X		X	X			X			
CASE 11D	01A2a_11D	SUM + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory	X	X		X	X	X		X		X		X	X	X	X		X	X			
CASE 11aD	01A2a_11aD	VAVS + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory	X	X		X	X	X		X			X	X	X	X	X		X	X			
CASE 12D	01A2a_12D	SUM + People + Occupancy sched + South window + north windows + Clerestory + DHW	X	X		X	X	X		X		X		X	X	X	X		X		X		
CASE 12aD	01A2a_12aD	VAVS + People + Occupancy sched + South window + north windows + Clerestory + DHW	X	X		X	X	X		X			X	X	X	X	X		X		X		
CASE 13D	01A2a_13D	SUM + South window + north windows + Clerestory + DHW	X	X		X	X			X		X		X		X	X		X		X		
CASE 13aD	01A2a_13aD	VAVS + South window + north windows + Clerestory + DHW	X	X		X	X			X			X	X		X	X		X		X		
CASE 14D	01A2a_14D	SUM + Plant + South window + north windows + Clerestory + Daylighting sensors	X	X		X	X			X		X		X		X	X		X			X	X
CASE 14aD	01A2a_14aD	VAVS + Plant + South window + north windows + Clerestory + Daylighting sensors	X	X		X	X			X			X	X		X	X		X			X	X
CASE 15D	01A2a_15D	SUM + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory + doors	X	X		X	X	X		X		X		X	X	X	X	X	X	X			
CASE 15aD	01A2a_15aD	VAVS + Plant + Trombe wall + People + Occupancy sched + South window + north windows + Clerestory + doors	X	X		X	X	X		X			X	X	X	X	X	X	X	X			
CASE 16D	01A2a_16D	SUM + DHW	X	X		X	X			X		X		X							X		
CASE 16aD	01A2a_16aD	VAVS + DHW	X	X		X	X			X			X	X							X		
CASE 17D	01A2a_17D	SUM + Photovoltaic	X	X		X	X			X		X		X									X
CASE 17aD	01A2a_17aD	VAVS + Photovoltaic	X	X		X	X			X			X	X									X
CASE 18D	01A2a_18D	SUM + Plant + Doors	X	X		X	X			X		X		X				X					
CASE 18aD	01A2a_18aD	VAVS + Plant + Doors	X	X		X	X			X			X	X				X					
CASE 19D	01A2a_19D	SUM (All features)	X	X		X	X			X		X		X	X	X	X	X	X	X	X	X	X
CASE 19aD	01A2a_19aD	VAVS (All features)	X	X		X	X			X			X	X	X	X	X	X	X	X	X	X	X

3.2 Analysis through DOE-2.1e

3.2.1 Manual Calculations using data from DOE-2.1e

The first simulations in DOE-2.1e were run and the next elements were found: one validation through code compliance and five manual calculations.

3.2.1.1 The First Manual Calculation.

The first manual calculation is a cross check that the U-Values in the simulation file meet or exceed the values of the code compliance ASHRAE Standard 90.1-2007 Energy Standard for Buildings except Low-Rise Residential Buildings.. If we look at the 01A1a_0aH file, the U-value of walls and roofs in the LV-D details in the exterior surfaces in the project report are 0.06

and 0.043, respectively (See Table 4). Table 5.5-2 for Building Envelope Requirements for Climate Zone 2 (Houston) in the *ASHRAE Standard 90.1-2007 Energy Standard for Buildings except Low-Rise Residential Buildings IP Edition* says that a wall, above grade—wood-framed and other – needs a U-value of 0.089 and that a roof with insulation entirely above deck needs a U-value of 0.048. Therefore, the building complies with the *ASHRAE Standard 90.1-2007 code* in terms of building envelope requirements.

Table 4: LV-D Report: Details of Exterior Surfaces in the Project for Houston

1NSF PROJECT TEST CASE-1 DOE-2.1E-119 Sat Dec 18 17:32:37 2010LDL RUN 1
ONE-ZONE MODEL
REPORT- LV-D DETAILS OF EXTERIOR SURFACES IN THE PROJECT WEATHER FILE- Houston TX TMY2

NUMBER OF EXTERIOR SURFACES 7 RECTANGULAR 5 OTHER 2
(U-VALUE INCLUDES OUTSIDE AIR FILM; WINDOW INCLUDES FRAME, IF DEFINED)

SURFACE	SPACE	- - - W I N D O W S - - - U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	- - - - W A L L - - - - U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	-W A L L + W I N D O W S- U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	AZIMUTH
BACK-1	SPACE1-1	0.000	0.00	0.060	800.00	0.060	800.00	NORTH
TOP-2	SPACE1-1	0.000	0.00	0.043	3780.40	0.043	3780.40	NORTH
RIGHT-1	SPACE1-1	0.000	0.00	0.060	700.00	0.060	700.00	EAST
FRONT-2	SPACE1-1	0.000	0.00	0.060	800.00	0.060	800.00	SOUTH
TOP-1	SPACE1-1	0.000	0.00	0.043	3160.56	0.043	3160.56	SOUTH
FRONT-1	SPACE1-1	0.000	0.00	0.060	800.00	0.060	800.00	SOUTH
LEFT-1	SPACE1-1	0.000	0.00	0.060	700.00	0.060	700.00	WEST

On the other hand, if we look at the 01A2a_0aD file for Denver, the U-value of walls and roofs in the LV-D Details in the Exterior Surfaces in the Project report are 0.04 and 0.043, respectively (See Table 5). Table 5.5-5 for Building Envelope Requirements for Climate Zone 5 (Denver) in the *ASHRAE Standard 90.1-2007 Energy Standard for Buildings except Low-Rise Residential Buildings IP Edition* says that a wall, above grade—wood-framed and other – needs a U-value of 0.064 and that a roof with insulation entirely above deck needs a U-value of 0.048. Therefore, the building complies with the code in terms of building envelope requirements.

Table 5: LV-D Report: Details of Exterior Surfaces in the Project for Denver

1NSF PROJECT TEST CASE-1 DOE-2.1E-119 Mon Aug 15 13:26:40 2011LDL RUN 1
ONE-ZONE MODEL
REPORT- LV-D DETAILS OF EXTERIOR SURFACES IN THE PROJECT WEATHER FILE- Boulder CO TMY2

NUMBER OF EXTERIOR SURFACES 7 RECTANGULAR 5 OTHER 2
(U-VALUE INCLUDES OUTSIDE AIR FILM; WINDOW INCLUDES FRAME, IF DEFINED)

SURFACE	SPACE	- - - W I N D O W S - - - U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	- - - - W A L L - - - - U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	-W A L L + W I N D O W S- U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	AZIMUTH
BACK-1	SPACE1-1	0.000	0.00	0.040	800.00	0.040	800.00	NORTH
TOP-2	SPACE1-1	0.000	0.00	0.043	3780.40	0.043	3780.40	NORTH
RIGHT-1	SPACE1-1	0.000	0.00	0.040	700.00	0.040	700.00	EAST
FRONT-2	SPACE1-1	0.000	0.00	0.040	800.00	0.040	800.00	SOUTH
TOP-1	SPACE1-1	0.000	0.00	0.043	3160.56	0.043	3160.56	SOUTH
FRONT-1	SPACE1-1	0.000	0.00	0.040	800.00	0.040	800.00	SOUTH
LEFT-1	SPACE1-1	0.000	0.00	0.040	700.00	0.040	700.00	WEST

3.2.1.2 The Second Manual Calculation

The second manual calculation compares the result of the steady-state "q" U-Value and the heating results for the LS-C Building Peak Load component report from the 01A1a_0aH file for Houston

q (Houston) = U x A x (Δt)

U-value walls = 0.06

U-value roofs = 0.043

A = 3,800 ft² (walls)

A = 6,941 ft² (roofs)

(Δt) = 73 – 32 = 41ºF (NOTE: A temperature of 32ºF is used in the calculation for the winter design degree day.

q = 20,005 Btu/hr.

The heating results for the LS-C Building Peak Load for the Houston component are 22,590 Btu/hr. The difference between the simulation and the manual calculation is 2,584.48 Btu/hr. The 6% difference is considered acceptable.The calculation difference should not be more than 10 %. Therefore, the simulation for Houston is working.

The following data was taken from the LS-C Building Peak Load component report from the 01A2a_0aD file for Denver:

q (Denver) = U x A x (Δt)

U-value walls = 0.04

U-value roofs = 0.043

A = 3,800 ft² (walls)

A = 6,941 ft² (roofs)

(Δt)= For Denver, an outside temperature of 72 is used73 – 1 = 72ºF (NOTE: The 1ºF is a temperature input in the winter design degree day.

q = 32,433 Btu/hr.

The heating results for the LS-C Building Peak Load for the Denver component are 32,960 Btu/hr. The difference between both numbers (527 Btu/hr.) will represent 1%. The calculation difference should not be more than 10 %. Therefore, the simulation for Denver is working, too.

3.2.1.3 The Third Manual Calculation

The third manual calculation tested the sensitivity of the size of the floor compared to the overall peak load. The analysis involved the comparison of the heating results from the LS-C Building Peak Load component between the basecase and several case files for Houston and Denver (see Figure 4 and Figure 5). For this simulation the building remained 10 ft. in the air and a floor was added to the building to the original 01A1a_0aH and 01A2a_0aD files for Houston and Denver, respectively. Then, the floor was changed into different sizes:

a. Half size (50 ft. X 50 ft.),
b. Total floor plan size (50 ft. X 100 ft.),
c. 150 % size (50 ft. X 150 ft.) and
d. 200 % size (50 ft. X 200 ft.)

These floor sizes correspond to the files 01A1a_1caH and 01A2a_1caD, 01A1a_1daH and 01A2a_1daD, 01A1a_1eaH and 01A2a_1eaD, and 01A1a_1faH and 01A2a_1faD, for Houston and Denver respectively. The results from the heating component of the files 01A1a_0aH, 01A1a_1caH, 01A1a_1daH, 01A1a_1eaH and 01A1a_1faH and 01A2a_0aD, 01A2a_1caD, 01A2a_1daD, 01A2a_1eaD and 01A2a_1faD showed a linear result. This linear result responded and increased due to the placement and size of the floor.

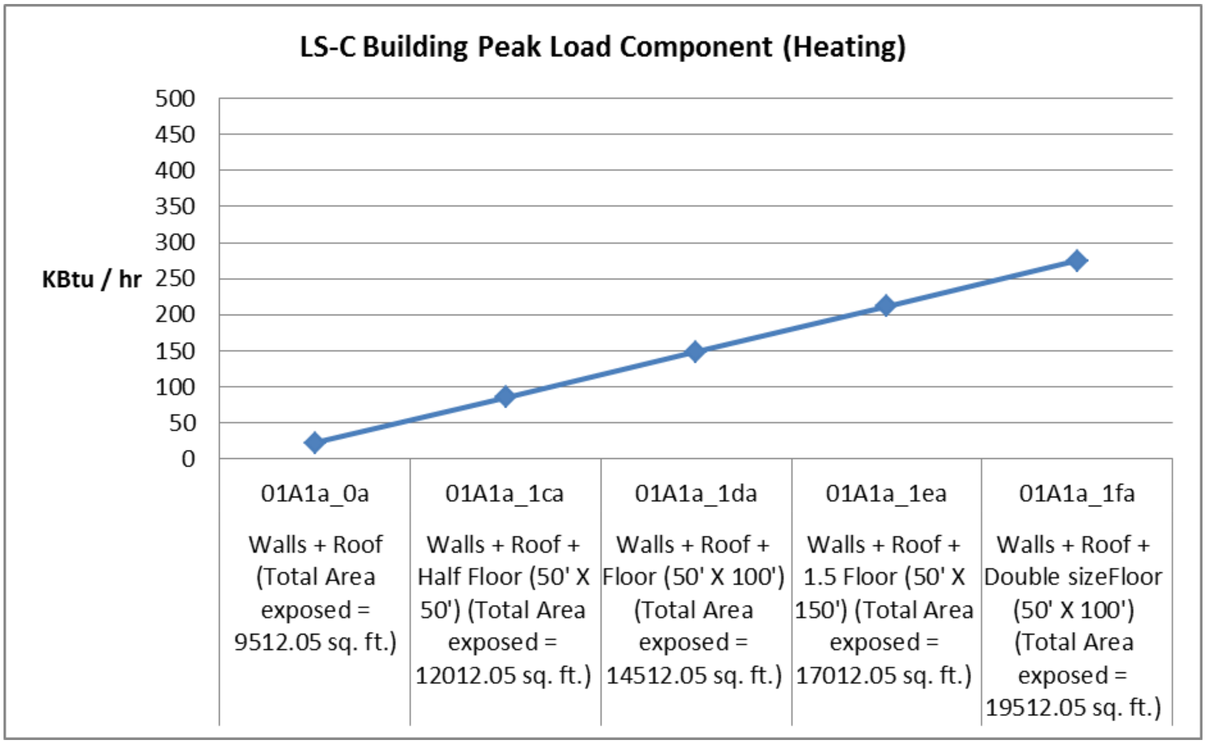


Figure 4: Comparison of heating results for increasing exposed floor area (uninsulated) for Houston

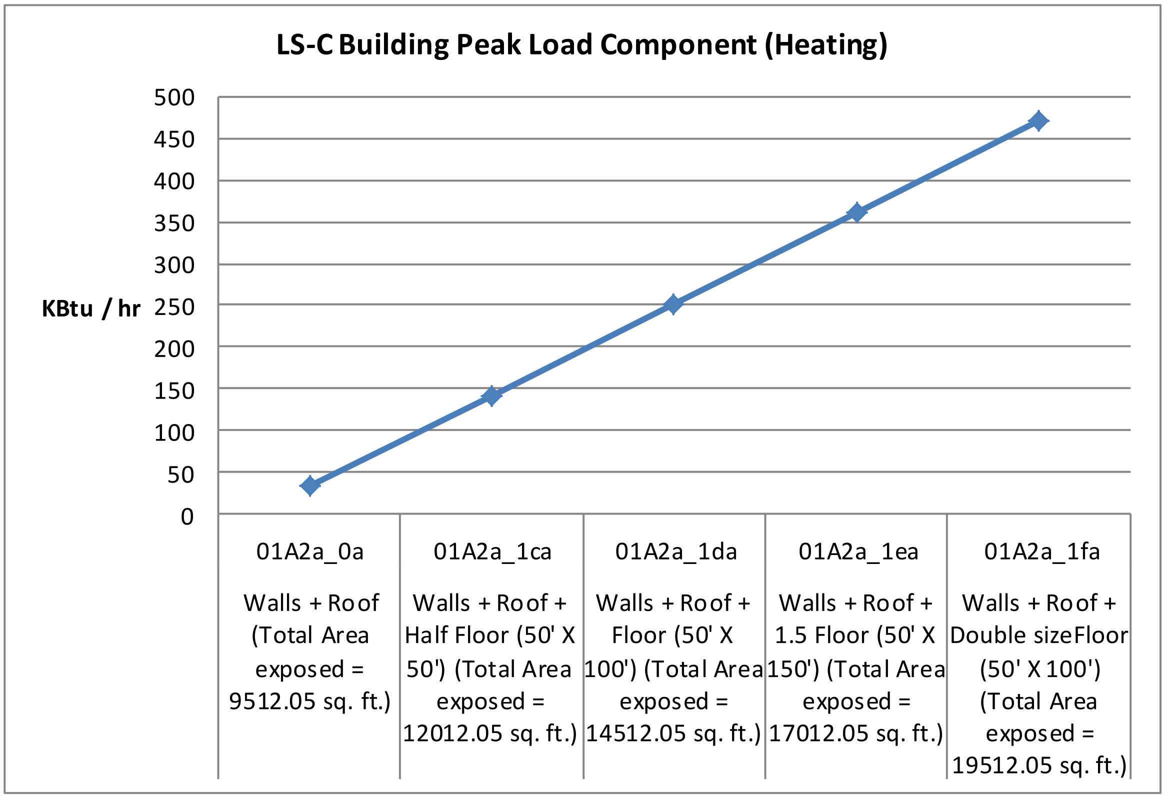


Figure 5: Comparison of heating results for increasing exposed floor area (uninsulated) for Denver

3.2.1.4 The Fourth Manual Calculation

The fourth manual calculation is for a building with insulated floor in both Houston and Denver. The method used for this calculation is found in the article *Underground Surfaces: How to get a better Underground Surface Heat Transfer Calculation in DOE-2.1e* by Fred Winkelmann (Building Energy Summary, 2002, p.19). The file 01A1a_2aH is for Houston and the file 01A2a_2aD is for Denver.

For Houston, we thought about a foundation depth of 4 ft. with R-10 exterior insulation (F2 = 0.50 Btu/hr-F-ft.) The average resistance film for heat flow up is 0.77 hr-ft²-F/Btu (Rfilm).

Slab surface area:	A = 50*100 = 5,000 ft²
Slab exposed perimeter:	Pexp = (2*50) + (2*100) = 300 ft.
Effective slab resistance:	Reff = A/(F2*Pexp) = 5000/(0.50*300) = 33.3
Effective slab U-value:	U-Effective = 1/Reff = 0.030
Actual slab resistance:	Rus = 0.44 + Rfilm = 0.44 + 0.77 = 1.21
Resistance of fictitious layer:	Rfic = Reff – Rus – Rsoil = 33.3 – 1.21 – 1.0 = 31.1

For Denver, we thought about a foundation depth of 4 ft. with R-20 exterior insulation (F2 = 0.40 Btu/hr-F-ft.) The average resistance film for heat flow up is 0.77 hr-ft²-F/Btu (Rfilm).

Slab surface area:	A = 50*100 = 5,000 ft²
Slab exposed perimeter:	Pexp = (2*50) + (2*100) = 300 ft.

Effective slab resistance: Reff = A/(F2*Pexp) = 5000/(0.40* 300) = 41.66
Effective slab U-value: U-Effective = 1/Reff = 0.024
Actual slab resistance: Rus = 0.44 + Rfilm = 0.44 + 0.77 = 1.21
Resistance of fictitious layer: Rfic = Reff – Rus – Rsoil = 41.66 – 1.21 – 1.0 = 39.45

3.2.1.5 The Fifth Manual Calculation

The fifth manual calculation shows the added south façade fenestration to the files 01A1a_4aH and 01A2a_4aD:

- The upper and lower south walls have 800 ft² each one (8 ft. X 100 ft.)
  - South window = 45 X 4 = 180 ft²
  - Clerestory = 90 X 3 = 270 ft²
- Window-to-wall ratio = South window (Lower south wall) = 33.75%
  Clerestory (Upper south wall) = 22.5%

This means that 1/3 of the area of the lower south wall is glass and ¼ (approx.) of the area of the upper south wall is glass. Also, if we add the areas of both walls and windows (separately), we will see that the total area of south wall is 1,600 ft², the total window area is 450 ft² and that the window-to-wall ratio will be 28%. Therefore, ¼ of the area of the south wall is only glass. The windows are the weakest elements in the thermal simulation.

3.2.1.6 The Sixth Manual Calculation

The sixth manual calculation shows the added total façade fenestration to the files 01A1a_8aH and 01A2a_8aD:

- The upper and lower south walls have 800 ft² each one (8 ft. X 100 ft.)
  - South window = 45 X 4 = 180 ft²
  - Trombé wall window = 50 X 8 = 400 ft²
  - Clerestory = 90 X 3 = 270 ft²
  - North windows = 24 X 4 = 96 ft² X 2 = 192 ft²
- Window-to-wall ratio = South window (Lower south wall) = 72.5%
  Clerestory (Upper south wall) = 22.5%
  North window = 24%

This means that 2/3 of the area of the lower south wall is glass, ¼ (approx.) of the area of the upper south wall is glass and ¼ of the area of the north wall is glass. In addition, if we add the areas of both walls and windows separately, we will see that the total area of the south wall is 1,600 ft², the total window area is 850 ft² and that the window-to-wall ratio will be 53% for south. Therefore, 1/2 of the area of the south and ¼ of the area of the north walls are only glass. The windows are the weakest elements in the thermal simulation.

3.2.2 Analysis using the DOE-2.1e Model

The files used for the final analysis in DOE-2.1e are the 01A1a_19aH for Houston and the 01A2a_19aD for Denver. The next features were simulated for both climates in order to save energy and achieve net-zero energy consumption: passive solar, daylighting saving controls, solar thermal energy (domestic hot water) and solar electric energy (photovoltaic). Figure 6 shows the office building with all the used features (southern and northern windows, clerestory, daylighting sensors, domestic hot water and photovoltaic).

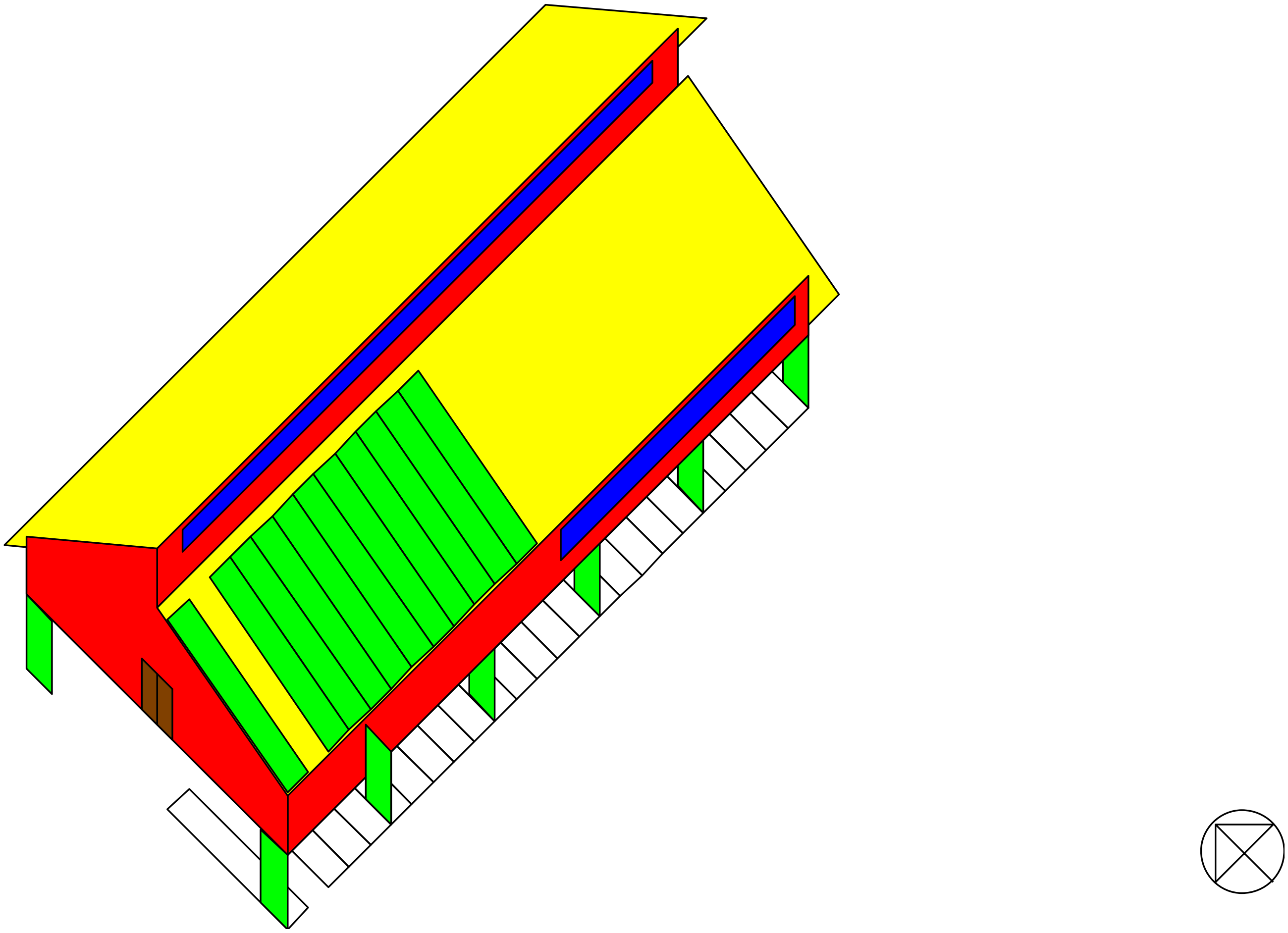


Figure 6: Office building with all features

Figures 7-9 show the following schedules: occupancy (Figure 7), lighting (Figure 8) and equipment (Figure 9).

```
$ ******************************************************   OCCUPANCY
SCHEDULE    ******************************************************
$
***************************************************************************
***********************************************************

OC-1              = DAY-SCHEDULE  (1,8)  (0.0)
                                  (9,11)  (1.0)
                                  (12,14)  (0.8,0.4,0.8)
                                  (15,18)  (1.0)
                                  (19,21)  (0.5,0.1,0.1)
                                  (22,24)  (0.0)             ..
OC-2             = DAY-SCHEDULE   (1,24)  (0.0)              ..
OC-WEEK          = WEEK-SCHEDULE  (WD) OC-1 (WEH) OC-2       ..
OCCUPY-1         = SCHEDULE       THRU DEC 31 OC-WEEK        ..
```

Figure 7: Occupancy Schedule used for Houston and Denver

```
$
*********************************************************************
*******************************************************
$ **************************************************   LIGHTING
SCHEDULE    **************************************************
$
*********************************************************************
*******************************************************

LT-1            =DAY-SCHEDULE       (1,8)  (0.05)
                                    (9,18)  (1.0)   $OFFICE2 LIGHTING
SCHEDULE HAS BEEN SET TO ONE DURING OFFICE HOURS.
                                    (19,24)  (0.05)..

LT-2            =DAY-SCHEDULE       (1,24)  (0.05)   ..

LT-WEEK         =WEEK-SCHEDULE      (MON,FRI)  LT-1    (WEH)  LT-2   ..

LIGHTS-1        =SCHEDULE           THRU DEC 31 LT-WEEK   ..
```

Figure 8: Lighting Schedule used for Houston and Denver

```
$
*********************************************************************
*******************************************************
$ **************************************************   EQUIPMENT
SCHEDULE    **************************************************
$
*********************************************************************
*******************************************************

EQ-1            =DAY-SCHEDULE       (1,8)  (0.02)
                                    (9,14)  (0.4,0.9,0.9,0.9,0.9,0.9)
                                    (15,20)  (0.8,0.7,0.5,0.5,0.3,0.3)
                                    (21,24)  (0.02)   ..
EQ-2            =DAY-SCHEDULE       (1,24)  (0.2)   ..
EQ-WEEK         =WEEK-SCHEDULE      (MON,FRI)  EQ-1   (WEH)  EQ-2   ..
EQUIP-1         =SCHEDULE            THRU DEC 31 EQ-WEEK   ..
```

Figure 9: Equipment Schedule used for Houston and Denver

Figure 10 shows the space characteristics input for Houston and Denver. It shows the space, the occupancy, the equipment and the lighting characteristics for the solar office building. No infiltration was used for the simulation.

```
$
*************************************************************************************************
**********************************
$ ****************************************************          SPACE1-1
**************************************************
$
*************************************************************************************************
**********************************

SPACE1-1              = SPACE
ZONE-TYPE             = CONDITIONED $ DOE2 DEFAULTS
AREA                  = 5000
VOLUME                = 70000
X                     = 0.0000
Y                     = 0.0000      $ DOE2 DEFAULTS
Z                     = 10.0000     $ DOE2 DEFAULTS
AZIMUTH               = 0.0000      $ DOE2 DEFAULTS
MULTIPLIER            = 1.0000      $ DOE2 DEFAULTS
FLOOR-WEIGHT          = 70          $ IECC 2001,402.1.3.3,DOE2 DEFAULTS IS 70
NUMBER-OF-PEOPLE      = 50
PEOPLE-SCHEDULE       = OCCUPY-1
PEOPLE-HEAT-GAIN      = 400         $ DOE2 DEFAULTS
PEOPLE-HG-LAT         = 130.3       $ DOE2 DEFAULTS
PEOPLE-HG-SENS        = 252.2       $ DOE2 DEFAULTS
EQUIP-SCHEDULE        = EQUIP-1
EQUIPMENT-W/SQFT      = 1           $ DOE2 DEFAULTS
AIR-CHANGES/HR        = 0.25        $ DOE2 DEFAULTS
TEMPERATURE           = (73)        $ DOE2 DEFAULTS
SOURCE-TYPE           = ELECTRIC    $ DOE2 DEFAULTS
SOURCE-POWER          = 0.0000      $ DOE2 DEFAULTS
EQUIP-LATENT          = 0.0000      $ DOE2 DEFAULTS
EQUIP-SENSIBLE        = 1.0000      $ DOE2 DEFAULTS
SOURCE-LATENT         = 0.5         $ DOE2 DEFAULTS
SOURCE-SENSIBLE       = 0.4         $ DOE2 DEFAULTS
FLOOR-MULTIPLIER      = 1.0000      $ DOE2 DEFAULTS
LIGHTING-SCHEDULE     = LIGHTS-1
LIGHTING-TYPE         = REC-FLUOR-RV
LIGHT-TO-SPACE        = 0.80
LIGHTING-W/SQFT       = 1.5
DAYLIGHTING           = YES         $ DAYLIGHING OPTION IS SWITCHED ON
LIGHT-REF-POINT1      = (25,25,2.7) $ LOCATION OF THE FIRST DAYLIGHT SENSOR
LIGHT-REF-POINT2      = (75,25,2.7) $ LOCTION OF THE SECOND DAYLIGHT SENSOR
ZONE-FRACTION1        = 0.5         $ FRACTION OF THE ZONE CONTROLLED BY SENSOR 1
ZONE-FRACTION2        = 0.5         $ FRACTION OF THE ZONE CONTROLLED BY SENSOR 2
LIGHT-SET-POINT1      = 50          $ TARGET ILLUMINATION (FC) REQUIRED AT SENSOR 1
LIGHT-SET-POINT2      = 50          $ TARGET ILLUMINATION (FC) REQUIRED AT SENSOR 2
LIGHT-CTRL-TYPE1      = CONTINUOUS  $ TYPE OF LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 1
LIGHT-CTRL-TYPE2      = CONTINUOUS  $ TYPE OF LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 2
MIN-POWER-FRAC        = 0           $ LOWEST INPUT POWER FRACTION FOR CONTINUOUSLY DIMMABLE
LIGHING CONTROL SYSTEM
MIN-LIGHT-FRAC        = 0           $ SPECIFIES THE FRACTIONAL LIGHT OUTPUT THAT A CONTINUOUSLY
DIMMABLE
                                    $ LIGHTING CONTROL SYSTEM PRODUCES AT THE MINIMUM FRACTIONAL
INPUT POWER GIVEN BY MIN-POWER-FRAC
```

Figure 10: Space characteristics input in DOE-2.1e for Houston and Denver

Figure 11 and Figure 12 show the hourly reports section used to plot the variables (clearness number, dry bulb temperature, building heating load sensible, building heating load latent, building cooling load sensible, building cooling load latent and building electric total) used for Houston and Denver, respectively. The dry bulb temperature variable is processed in this section. The dry bulb temperature is used to calculate the heat loss that is input for the F-Chart.

```
 $---HOURLY REPORTS---$

PLTSCH  = SCHEDULE   THRU JAN 14 (ALL) (1,24) (1)
                     THRU AUG 9 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24) (1)   ..

PLOTER1 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (1, 4, 6)    ..  $ CLEARNESS NUMBER, DRY BULB
TEMPERATURE (°F), CLOUD AMOUNT (0 TO 10) FROM REFERENCE PT1 III.101

PLOTER2 = REPORT-BLOCK
          VARIABLE-TYPE = BUILDING
          VARIABLE-LIST = (1, 2, 19, 20, 37)    .. $ BUILDING HEATING LOAD
(SENSIBLE), BUILDING HEATING LOAD (LATENT), BUILDING COOLING LOAD
(SENSIBLE), BUILDING COOLING LOAD (LATENT), BUILDING ELECTRIC TOTAL FROM
REFERENCE PT1 III.103 AND III.104

LDS-REP-1 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH
            REPORT-BLOCK    = (PLOTER1, PLOTER2)
            OPTION          = PRINT    ..

END  ..
COMPUTE  LOADS   ..
```

Figure 11: Hourly reports calculation command lines in DOE-2.1e for Loads for Houston

```
 $---HOURLY REPORTS---$

PLTSCH  = SCHEDULE   THRU FEB 3 (ALL) (1,24) (1)
                     THRU AUG 25 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24) (1)   ..

PLOTER1 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (1, 4, 6)    ..  $ CLEARNESS NUMBER, DRY BULB
TEMPERATURE (°F), CLOUD AMOUNT (0 TO 10) FROM REFERENCE PT1 III.101

PLOTER2 = REPORT-BLOCK
          VARIABLE-TYPE = BUILDING
          VARIABLE-LIST = (1, 2, 19, 20, 37)    .. $ BUILDING HEATING LOAD
(SENSIBLE), BUILDING HEATING LOAD (LATENT), BUILDING COOLING LOAD
(SENSIBLE), BUILDING COOLING LOAD (LATENT), BUILDING ELECTRIC TOTAL FROM
REFERENCE PT1 III.103 AND III.104

LDS-REP-1 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH
            REPORT-BLOCK    = (PLOTER1, PLOTER2)
            OPTION          = PRINT    ..

END  ..
COMPUTE  LOADS   ..
```

Figure 12: Hourly reports calculation command lines in DOE-2.1e for Loads for Denver

Figure 13 is the input systems section for the system schedules for the fans, the heating, the cooling and the ventilation simulated for Houston and Denver. The SS-A report for total heating energy is processed in this section. The total heating energy is used to calculate the heat loss that is input for the F-Chart.

```
INPUT SYSTEMS   INPUT-UNITS = ENGLISH        $DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH ..    $DOE-2 DEFAULT(OR METRIC)

               SYSTEMS-REPORT  SUMMARY = (ALL-SUMMARY)
                               VERIFICATION     = (SV-A)
                               REPORT-FREQUENCY = HOURLY
                               HOURLY-DATA-SAVE = NO-SAVE ..

               $ SYSTEMS SCHEDULES

FAN-1          =DAY-SCHEDULE       (1,24) (1)    ..
FAN-2          =DAY-SCHEDULE       (1,24) (1)    ..
FAN-SCHED      =SCHEDULE           THRU DEC 31 (WD) FAN-1 (WEH) FAN-2 ..

HEAT-1      =DAY-SCHEDULE    (1,24) (68)    ..
HEAT-2      =DAY-SCHEDULE    (1,24) (68)    ..
HEAT-WEEK   =WEEK-SCHEDULE   (MON,FRI)  HEAT-1   (WEH)  HEAT-2   ..
HEAT-SCHED  =SCHEDULE        THRU DEC 31   HEAT-WEEK   ..
COOLOFF     =SCHEDULE        THRU DEC 31 (ALL) (1,24) (1)  ..
HEATOFF     =SCHEDULE        THRU DEC 31 (ALL) (1,24) (1)  ..

COOL-1      =DAY-SCHEDULE    (1,24) (78)    ..
COOL-2      =DAY-SCHEDULE    (1,24) (78)    ..
COOL-WEEK   =WEEK-SCHEDULE   (MON,FRI)  COOL-1   (WEH)  COOL-2   ..
COOL-SCHED  =SCHEDULE        THRU DEC 31   COOL-WEEK   ..

VENT-1      =DAY-SCHEDULE    (1,24) (1)    ..
VENT-2      =DAY-SCHEDULE    (1,24) (1)    ..
VENT-WEEK   =WEEK-SCHEDULE   (MON,FRI)  VENT-1   (WEH)  VENT-2   ..
VENT-SCH    =SCHEDULE        THRU DEC 31   VENT-WEEK ..

R1          =DAY-RESET-SCH   SUPPLY-HI=60   SUPPLY-LO=52
                             OUTSIDE-LO=30  OUTSIDE-HI=75  ..
SAT-RESET   =RESET-SCHEDULE  THRU DEC 31 (ALL) R1  ..
```

Figure 13: Input Systems for Loads in DOE-2.1e for Houston and Denver

Figure 14 is a section of the description of the System Input used for the solar office building for Houston and Denver. The System-Type=VAVS is the system assigned to the office building. The System-Type=SUM is the system assigned to simulate the building heating and cooling loads considering the thermostat set-points without simulating the system (i.e., VAVS for this building). This will provide heating loads excluding the impacts of the efficiency and part-load performance of the heating system. Figure 15 is the section of the Systems Input where the DHW is assigned for the solar office building for Houston and Denver. The following elements are contained in this section: DHW-Type=Electric, a schedule and the number of gallons that are required from ASHRAE 90.1 User's Manual for the 50 people in the office. Figure 16 shows the section of the Plant Input where the PS-E report is produced for the final graphs.

```
                 $ SYSTEM DESCRIPTION

ZAIR        -ZONE-AIR      OA-CFM/PER-0..

CONTROL     -ZONE-CONTROL  DESIGN-HEAT-T-70  DESIGN-COOL-T-76
                           HEAT-TEMP-SCH- HEAT-SCHED
                           COOL-TEMP-SCH- COOL-SCHED
                           THERMOSTAT-TYPE-REVERSE-ACTION..

                   $ FOLLOWING AIR FLOWS ARE FROM RUN 3 SV-A REPORT,
                   $ DIVIDED BY ALTITUDE MULTIPLIER

SPACE1-1    -ZONE          ZONE-AIR-ZAIR  SIZING-OPTION-ADJUST-LOADS
                           ZONE-CONTROL      - CONTROL
                           ZONE-TYPE         - CONDITIONED
                           TROM-VENT-SCH     - VENT-SCH
                           BASEBOARD-RATING  =   0.00       $ BTU/HR
                           PANEL-LOSS-RATIO  =   0.00       $ BTU/BTU
                           EXHAUST-EFF       -   0.75   $ FRAC. OR MULT.
                           BASEBOARD-CTRL    - OUTDOOR-RESET
                           THROTTLING-RANGE  =   1.00       $ R
                           ZONE-FAN-KW/FLOW  =   0.0003     $ KW/CFM
                           TERMINAL-TYPE     - SVAV
                           ZONE-REPORTS      = YES   ..

S-CONT      -SYSTEM-CONTROL  COOLING-SCHEDULE- COOLOFF
                             HEATING-SCHEDULE- HEATOFF
                             HEAT-SET-T-65
                             COOL-CONTROL-RESET
                             COOL-RESET-SCH-SAT-RESET
                             MIN-SUPPLY-T-60..

S-FAN       -SYSTEM-FANS     FAN-SCHEDULE-FAN-SCHED  FAN-CONTROL-SPEED
                             SUPPLY-STATIC-2.0  SUPPLY-EFF-.55
                             NIGHT-CYCLE-CTRL-CYCLE-ON-ANY..

S-TERM      -SYSTEM-TERMINAL REHEAT-DELTA-T-58
                             MIN-CFM-RATIO-0.1..

SYST-1      -SYSTEM          SYSTEM-TYPE-VAVS
                             SUPPLY-CFM            - 7366
                             SYSTEM-CONTROL        - S-CONT
                             SYSTEM-FANS           - S-FAN
                             SYSTEM-TERMINAL       - S-TERM
                             ECONO-LIMIT-T         - 65
                             ZONE-NAMES            - (SPACE1-1)
                             HEAT-SOURCE           - ELECTRIC
                             ZONE-HEAT-SOURCE      - ELECTRIC
                             PREHEAT-SOURCE        - ELECTRIC
                             BASEBOARD-SOURCE      - ELECTRIC
                             VARIABLE-T            - ON
                             SIZING-RATIO       - 1.00 $ DOE-2.1 DEFAULT
                             HEAT-SIZING-RATIO  = 1.00 $ DOE-2.1 DEFAULT
                             COOL-SIZING-RATIO  = 1.00 $ DOE-2.1 DEFAULT
```

Figure 14: System Input in DOE-2.1e for Houston and Denver

```
PLANT1    - PLANT-ASSIGNMENT  SYSTEM-NAMES - (SYST-1) $ REFERENCE FROM
THE IECC1107 FILE
                              DHW-TYPE     - ELECTRIC
                              DHW-SCH      - DHWSCH-1
                              DHW-GAL/MIN  = 0.03472   .. $CALCULATED
FROM ASHRAE 90.1 USER'S MANUAL PAGE 7-14

DHWSCH-1  = SCHEDULE  THRU JAN 14 (ALL) (1,24) (1)
                     THRU AUG 9 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24) (1)   ..

PLTSCH2  = SCHEDULE  THRU JAN 14 (ALL) (1,24) (1)
                     THRU AUG 9 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24) (1)   ..

PLOTER3 - REPORT-BLOCK
          VARIABLE-TYPE - GLOBAL
          VARIABLE-LIST - (8)..  $ DRY BULB TEMPERATURE (°F) FROM
SUPLEMENT PAGE A.16

PLOTER4 - REPORT-BLOCK
          VARIABLE-TYPE - PLANT1
          VARIABLE-LIST - (1, 2, 3)..  $ TOTAL COOLING LOAD (Btu/hr),
TOTAL HEATING LOAD (Btu/hr), TOTAL ELECTRICAL LOAD (Kw) FROM SUPLEMENT
PAGE A.48

LDS-REP-2 - HOURLY-REPORT
            REPORT-SCHEDULE - PLTSCH2
            REPORT-BLOCK    - (PLOTER3, PLOTER4)
            OPTION          - PRINT..

END..
COMPUTE SYSTEMS..
INPUT PLANT     INPUT-UNITS - ENGLISH        $DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS - ENGLISH..     $DOE-2 DEFAULT(OR METRIC)

PLANT1 - PLANT-ASSIGNMENT..
```

Figure 15: Plant Assignment Input for DHW in DOE-2.1e for Houston and Denver

```
              PLANT-REPORT  SUMMARY-(PS-A, PS-E, BEPS)  ..

                $ EQUIPMENT DESCRIPTION

                $ HOT-WATER BOILER

SBOIL1   -PLANT-EQUIPMENT  TYPE-HW-BOILER  SIZE--999   .. $ AUTOSIZE

          PLANT-PARAMETERS  HERM-REC-COND-TYPE-AIR  ..

                $ AIR-COOLED RECIPROCATING CHILLER

CHIL1    -PLANT-EQUIPMENT  TYPE-HERM-REC-CHLR  SIZE--999  .. $ AUTOSIZE

 PLANT-COSTS      PROJECT-LIFE-25  DISCOUNT-RATE-5 ..
 ENERGY-RESOURCE  RESOURCE-ELECTRICITY  ..
 ENERGY-RESOURCE  RESOURCE-NATURAL-GAS  ENERGY/UNIT-100000
                  UNIT-NAME-THERMS

END
COMPUTE PLANT
STOP
```

Figure 16: Plant Input in DOE-2.1e for Houston and Denver

3.3 Analysis through Inverse Model Toolkit (IMT)

Table 6 shows the total monthly heating energy from the SS-A report and the average monthly dry bulb temperature from the Loads Report from the files (01A1a_19H for Houston and 01A2a_19D for Denver). These results were obtained using system SUM in DOE-2.1e and were input to the IMT.

Table 6: Total Heating energy (SS-A report) and Dry Bulb temperature (Loads report) results

	Houston		Denver	
Months	Heating	Temperature	Heating	Temperature
Jan	781,161	53.4	5,045,419	30.2
Feb	305,806	51.6	3,896,516	33
Mar	0	61.2	1,710,968	38.4
Apr	0	68.9	548,903	48.6
May	0	75.1	34,839	56.4
Jun	0	79.8	0	65
Jul	0	82.4	0	73.5
Aug	0	81.1	0	70.1
Sep	0	77.5	0	62.4
Oct	0	69.7	63,484	51.4
Nov	0	62.8	1,350,194	38.2
Dec	227,613	52.6	4,996,645	29.1

Figure 17 presents the monthly heating energy consumption for Houston. There are clearly three lines in the graph: a line that represents the heating energy consumption between January and March; a horizontal line that represents low heating energy consumption between March and November and the last line that represents the heating energy consumption from November to December. The units used were Btu/hr. Figure 18 presents the monthly heating energy consumption for Denver. There are three lines in the graph: a line that represents the heating energy consumption between January and May; a horizontal line that represents low heating energy consumption between May and October and the last line that represents the heating energy consumption from October to December. The units used were Btu/hr.

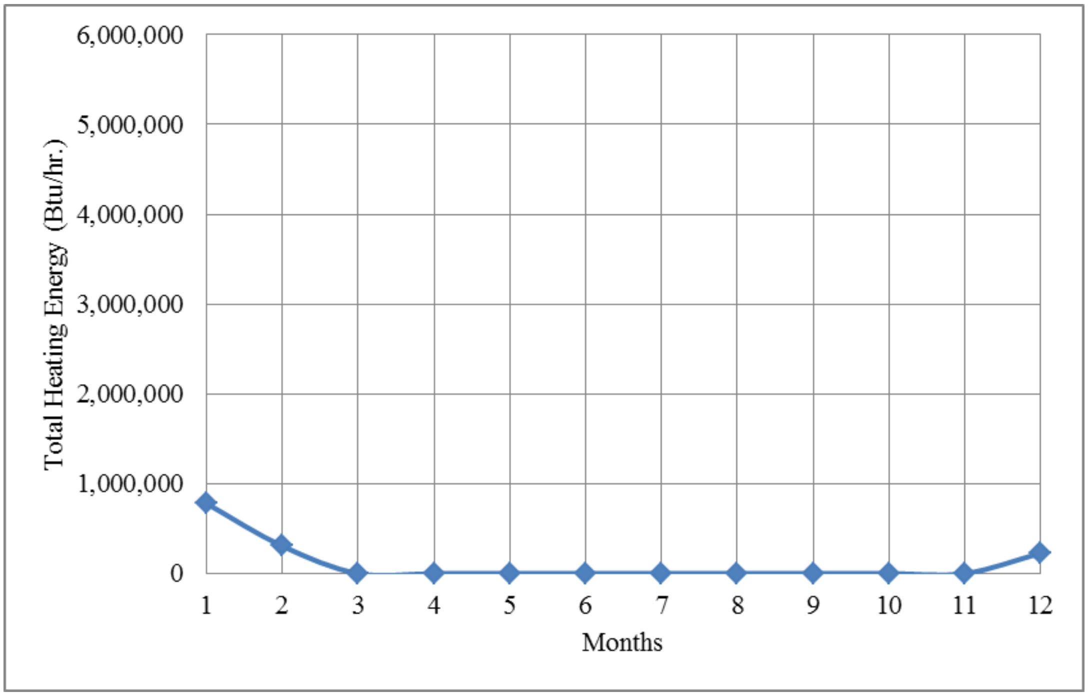


Figure 17: Monthly total heating energy consumption from SS-A report for Houston

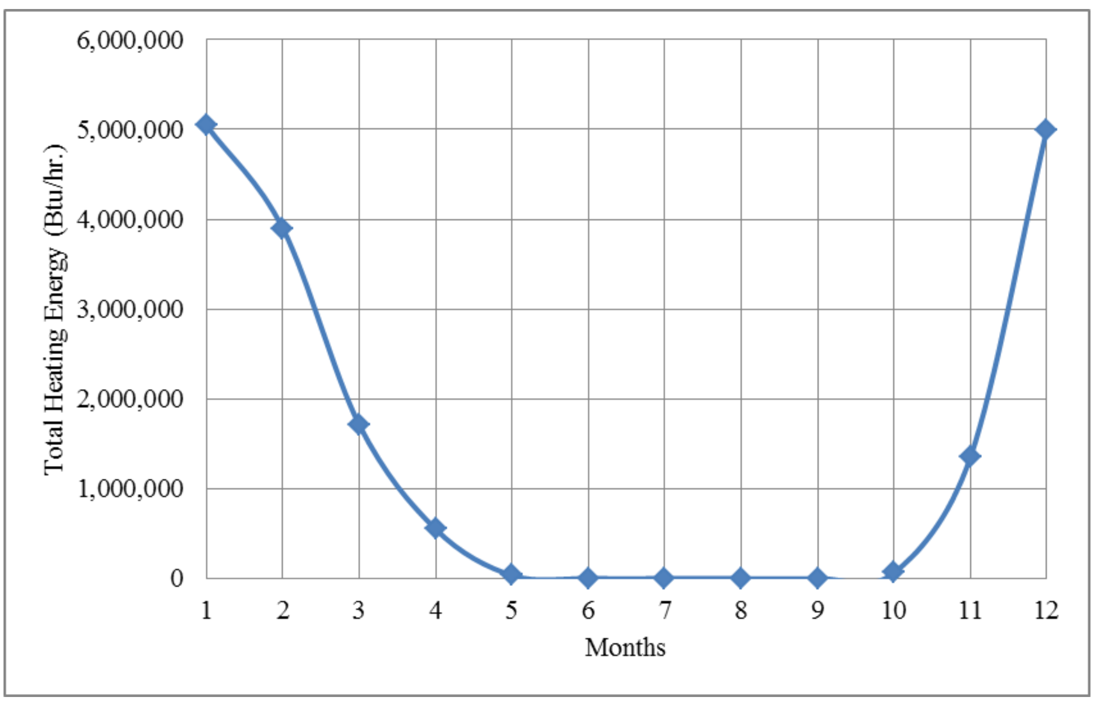
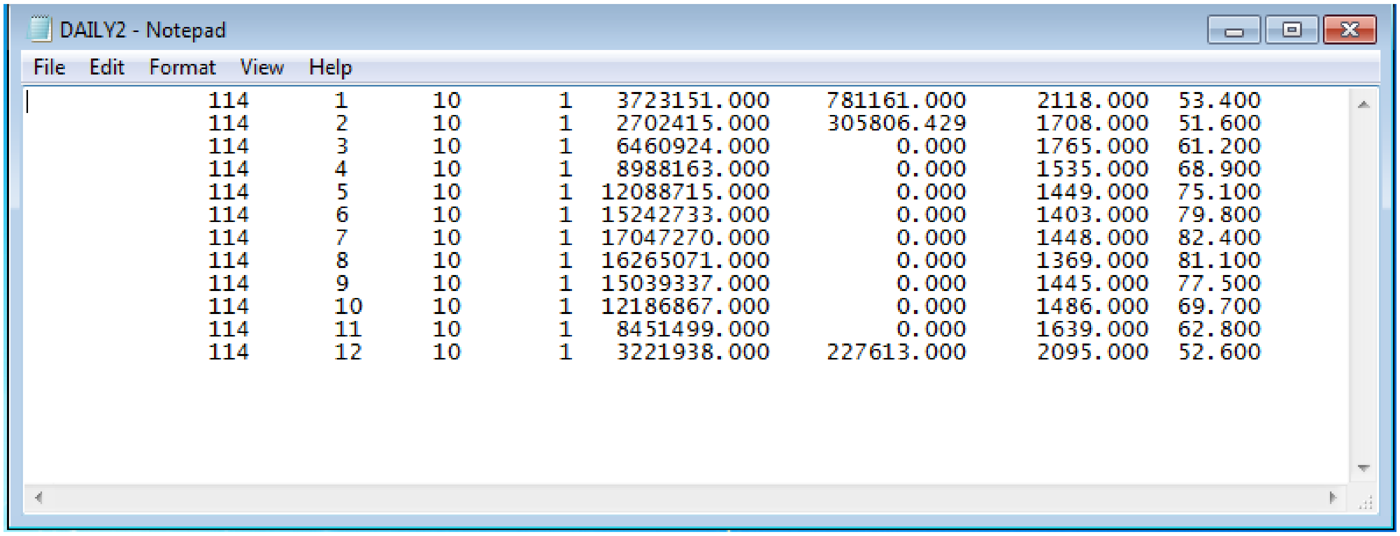


Figure 18: Monthly total heating energy consumption from SS-A report for Denver

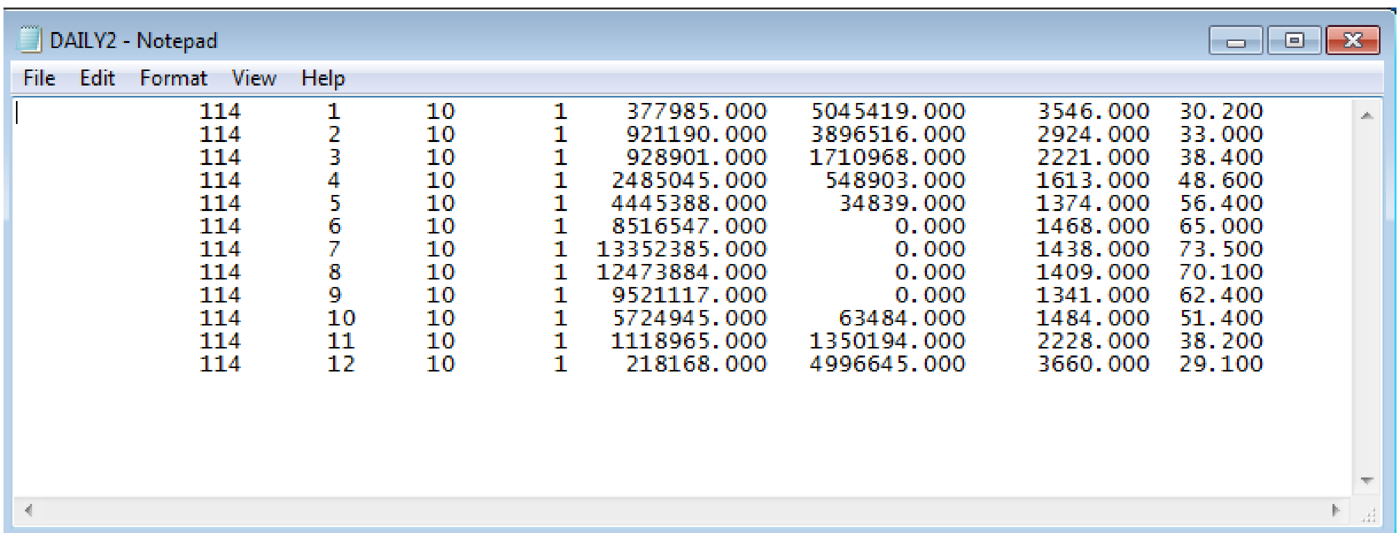
The data was input in the Daily2.dat file (Figure 19 and Figure 20). The 1st column is the file type, the 2nd column is the month, the 3rd column is the year, the 4th column indicates the residual file, the 5th column is the cooling energy, the 6th column is the heating energy, the 7th column is the electricity, and the 8th column is the dry bulb temperature.


DAILY2 - Notepad

File Edit Format View Help

114	1	10	1	3723151.000	781161.000	2118.000	53.400
114	2	10	1	2702415.000	305806.429	1708.000	51.600
114	3	10	1	6460924.000	0.000	1765.000	61.200
114	4	10	1	8988163.000	0.000	1535.000	68.900
114	5	10	1	12088715.000	0.000	1449.000	75.100
114	6	10	1	15242733.000	0.000	1403.000	79.800
114	7	10	1	17047270.000	0.000	1448.000	82.400
114	8	10	1	16265071.000	0.000	1369.000	81.100
114	9	10	1	15039337.000	0.000	1445.000	77.500
114	10	10	1	12186867.000	0.000	1486.000	69.700
114	11	10	1	8451499.000	0.000	1639.000	62.800
114	12	10	1	3221938.000	227613.000	2095.000	52.600

Figure 19: IMT file used for Houston


DAILY2 - Notepad

File Edit Format View Help

114	1	10	1	377985.000	5045419.000	3546.000	30.200
114	2	10	1	921190.000	3896516.000	2924.000	33.000
114	3	10	1	928901.000	1710968.000	2221.000	38.400
114	4	10	1	2485045.000	548903.000	1613.000	48.600
114	5	10	1	4445388.000	34839.000	1374.000	56.400
114	6	10	1	8516547.000	0.000	1468.000	65.000
114	7	10	1	13352385.000	0.000	1438.000	73.500
114	8	10	1	12473884.000	0.000	1409.000	70.100
114	9	10	1	9521117.000	0.000	1341.000	62.400
114	10	10	1	5724945.000	63484.000	1484.000	51.400
114	11	10	1	1118965.000	1350194.000	2228.000	38.200
114	12	10	1	218168.000	4996645.000	3660.000	29.100

Figure 20: IMT file used for Denver

Figure 21 shows the parameters used to run the simulation in the IMT. Some parameters were changed in the Daily2ins.txt (Figure21) such as the Model type=4 (this means a 3 point heating type simulation), the "y" variable is the heating energy and the "x" variable is the dry bulb temperature. The model type ran for the two cities were the 4: 3ph (Three point heating). The 6^{th} column number is the dependent "y" variable is the one that corresponds to the heating energy from the SS-A report from DOE-2.1e. The 8th column is the independent variable $X_1 = 8$ is the one that corresponds to the average monthly dry bulb temperature from the Loads report.

Figure 21: Parameters changed to run the simulation for Houston and Denver

The Daily2ins.txt file is ran in IMT and the Building UA number is equal to the LS line in Figure 22 (left) for Houston and (right) for Denver. These two numbers are input to the F-Chart files to calculate the DHW for the solar office building.

```
IMT - Notepad
File  Edit  Format  View  Help
*********************************************
 ASHRAE INVERSE MODELING TOOLKIT (1.9)
*********************************************
    Output file name = IMT.Out
*********************************************
    Input data file name =  daily2.dat
    Model type =           3P Heating
    Grouping column No =     4
    Value for grouping =     1
    Residual mode =          1
    # of X(Indep.) Var =     1
    Y1 column number =       6
    X1 column number =    8
    X2 column number =    0 (unused)
    X3 column number =    0 (unused)
    X4 column number =    0 (unused)
    X5 column number =    0 (unused)
    X6 column number =    0 (unused)
*********************************************
    Regression Results
   --------------------------------------
            N =      12
   --------------------------------------
           R2 =      0.639
   --------------------------------------
        AdjR2 =      0.639
   --------------------------------------
         RMSE = 148561.0781
   --------------------------------------
      CV-RMSE =    135.612%
   --------------------------------------
            p =     -0.820
   --------------------------------------
           DW =      1.589 (p>0)
   --------------------------------------
           N1 =        4
   --------------------------------------
           N2 =        8
   --------------------------------------
          Ycp =    -663.9735 (   50250.8203)
   --------------------------------------
           LS = -41391.7383 (    9836.2197)
   --------------------------------------
           RS =       0.0000 (       0.0000)
   --------------------------------------
          Xcp =      62.6880 (       0.6160)
   --------------------------------------
   --------------------------------
```

```
IMT - Notepad
File  Edit  Format  View  Help
*********************************************
 ASHRAE INVERSE MODELING TOOLKIT (1.9)
*********************************************
    Output file name = IMT.Out
*********************************************
    Input data file name =  daily2.dat
    Model type =           3P Heating
    Grouping column No =     4
    Value for grouping =     1
    Residual mode =          1
    # of X(Indep.) Var =     1
    Y1 column number =       6
    X1 column number =    8
    X2 column number =    0 (unused)
    X3 column number =    0 (unused)
    X4 column number =    0 (unused)
    X5 column number =    0 (unused)
    X6 column number =    0 (unused)
*********************************************
    Regression Results
   --------------------------------------
            N =      12
   --------------------------------------
           R2 =      0.988
   --------------------------------------
        AdjR2 =      0.988
   --------------------------------------
         RMSE = 229507.6719
   --------------------------------------
      CV-RMSE =     15.607%
   --------------------------------------
            p =      0.386
   --------------------------------------
           DW =      1.092 (p>0)
   --------------------------------------
           N1 =        5
   --------------------------------------
           N2 =        7
   --------------------------------------
          Ycp =  74819.4688 (   81926.3828)
   --------------------------------------
           LS =-387711.3750 (   13386.6143)
   --------------------------------------
           RS =       0.0000 (       0.0000)
   --------------------------------------
          Xcp =      42.4200 (       0.8880)
   --------------------------------------
   --------------------------------
```

Figure 22: IMT final result for Houston (left) and Denver (right)

3.4 Analysis through F-Chart

The F-Chart software was used to simulate the Domestic Hot Water (DHW) of the office building. The following parameters were used: the building geometry, area, people, tank size, data from DOE-2.1e, the IMT result, the chosen active storage system and flat-plate collector characteristics to simulate the DHW into F-Chart for Houston and Denver. Table 7 and Table 8 present these parameters.

Table 7: Parameters input to F-Chart for Houston

Element	Amount	Units
Floors	**1**	
Large side (floor plan)	**100**	**ft²**
Width side (floor plan)	**50**	**ft²**
Area of floor plan	**5,000**	**ft²**
Total Area of building	**5,000**	**ft²**
People	**50**	
Tank size	**50**	**gal**
Domestic Hot Water requirements	**1**	**gal/day/person**
Location	**Houston**	
Building UA	**30,887**	**Btu/hr-°F**
Building Storage Capacity	**30,000**	**Btu/°F**
Low Thermostat Set Temperature	**68**	**°F**
Daily Internal Generation	**0.1**	**Btu/day**
Allowable Temperature Swing	**10**	**°F**
Fuel	**Electricity**	
Efficiency of fuel usage	**100**	**%**
Duct losses	**No**	
Domestic hot water	**Yes**	
Daily hot water usage	**100**	**gal**
Water set temperature	**140**	**°F**
Environmental temperature	**68**	**°F**
UA of auxiliary storage tank	**7.6**	**Btu/hr-°F**
Heat Exchanger Water Flowrate	**2,000**	**lb/hr.**
Air-Water Heat Exch. Effectiveness	**0.5**	
Number of collector panels	**3**	
Collector panel area	**32**	**ft²**
FR*UL (Test slope)	**0.74**	**Btu/hr-ft²-°F**
FR*Tau*ALPHA(Test intercept)	**0.7**	
Collector slope	**18**	**° (Degrees)**
Collector azimuth (South=0)	**0**	**° (Degrees)**
Incidence angle modifier calculation	**Glazings**	
Number of glass covers	**1**	
Collector flowrate/area	**11.06**	**lb/hr-ft²**
Collector fluid specific heat	**1**	**Btu/lb-°F**
Modify test values	**No**	

Table 8: Parameters input to F-Chart for Denver

Element	Amount	Units
Floors	**1**	
Large side (floor plan)	**100**	**ft²**
Width side (floor plan)	**50**	**ft²**
Area of floor plan	**5,000**	**ft²**
Total Area of building	**5,000**	**ft²**
People	**50**	
Tank size	**50**	**gal**
Domestic Hot Water requirements	**1**	**gal/day/person**
Location	**Denver**	
Building UA	**30,887**	**Btu/hr-°F**
Building Storage Capacity	**30,000**	**Btu/°F**
Low Thermostat Set Temperature	**68**	**°F**
Daily Internal Generation	**0.1**	**Btu/day**
Allowable Temperature Swing	**10**	**°F**
Fuel	**Electricity**	
Efficiency of fuel usage	**100**	**%**
Duct losses	**No**	
Domestic hot water	**Yes**	
Daily hot water usage	**100**	**gal**
Water set temperature	**140**	**°F**
Environmental temperature	**68**	**°F**
UA of auxiliary storage tank	**7.6**	**Btu/hr-°F**
Heat Exchanger Water Flowrate	**2,000**	**lb/hr.**
Air-Water Heat Exch. Effectiveness	**0.5**	
Number of collector panels	**3**	
Collector panel area	**32**	**ft²**
FR*UL (Test slope)	**0.74**	**Btu/hr-ft²-°F**
FR*Tau*ALPHA(Test intercept)	**0.7**	
Collector slope	**18**	**° (Degrees)**
Collector azimuth (South=0)	**0**	**° (Degrees)**
Incidence angle modifier calculation	**Glazings**	
Number of glass covers	**1**	
Collector flowrate/area	**11.06**	**lb/hr-ft²**
Collector fluid specific heat	**1**	**Btu/lb-°F**
Modify test values	**No**	

Figure 23 and Figure 24 show the results for the DHW for Houston and Denver, respectively. The output has monthly results in MMBtu for the following elements: 1) "*Solar*" is the total solar radiation incidence on the flat-plate collector surface, 2) "*Heat*" is the total space heating demand, 3) "*Dhw*" is the total water heating demand, 4) "*Aux*" is the total auxiliary energy that is required to supply the space and domestic hot water demands and 5) "*f*" is the fraction of the space and domestic hot water demands that is supplied by the flat-plate collector. The *"Dhw"* and the *"Aux"* columns will be used for the final graph.

Thermal Output

	Solar [10^6 Btu]	Heat [10^6 Btu]	Dhw [10^6 Btu]	Aux [10^6 Btu]	f [ ]
Jan	3.245	529.8	2.360	530.4	0.003
Feb	3.178	367.5	2.118	367.8	0.005
Mar	4.326	233.1	2.272	232.8	0.011
Apr	4.567	64.7	2.080	64.7	0.032
May	4.993	12.7	2.014	12.2	0.170
Jun	5.189	0.0	1.847	0.3	0.813
Jul	5.613	0.0	1.834	0.3	0.853
Aug	5.160	0.0	1.845	0.4	0.798
Sep	4.893	0.0	1.861	0.4	0.774
Oct	4.577	72.6	2.045	72.5	0.029
Nov	3.519	184.7	2.111	184.7	0.011
Dec	3.035	420.4	2.282	421.1	0.004
Year	52.294	1885.6	24.669	1887.7	0.012

Figure 23: Final results from F-Chart for Houston

Thermal Output

	Solar [10^6 Btu]	Heat [10^6 Btu]	Dhw [10^6 Btu]	Aux [10^6 Btu]	f [ ]
Jan	3.310	9981	2.753	9982	0.000
Feb	3.376	9408	2.506	9409	0.000
Mar	5.050	7222	2.740	7222	0.000
Apr	4.606	7137	2.566	7137	0.000
May	5.998	2571	2.534	2570	0.001
Jun	6.527	252	2.350	252	0.010
Jul	6.300	384	2.327	384	0.007
Aug	5.872	333	2.302	333	0.007
Sep	5.282	1073	2.263	1072	0.003
Oct	4.262	5217	2.428	5217	0.000
Nov	2.996	8600	2.463	8601	0.000
Dec	2.770	9646	2.647	9647	0.000
Year	56.349	61825	29.879	61828	0.000

Figure 24: Final results from F-Chart for Denver

3.5 Analysis through PV F-Chart

The PV F-Chart software was used to simulate photovoltaic. The following parameters were used: the building geometry, area, people, tank size, data from DOE-2.1e, chosen flat-plate array characteristics to simulate the photovoltaic into PV F-Chart for Houston and Denver. Table 9 and Table 10 present these parameters. The array slope for the PV was originally the same slope of the southern roof of the building (18°). A second option is added when the array slope was changed to 30° for Houston and 40° for Denver.

Table 9: Parameters input to PV F-Chart for Houston

Element	Amount	Units
Floors	**1**	
Large side (floor plan)	**100**	**ft²**
Width side (floor plan)	**50**	**ft²**
Area of floor plan	**5,000**	**ft²**
Total Area of building	**5,000**	**ft²**
City	**Houston**	
Cell Temperature (NOCT conditions)	**0.5**	**°F**
Array reference efficiency	**0.15**	
Array reference temperature	**82.4**	**°F**
Array temperature coefficient*1000	**2.389**	**1/°F**
Power tracking efficiency	**0.9**	
Power conditioning efficiency	**0.88**	
% Standard deviation of load	**0**	**%**
Array area (no. of panels X panel area)	**96**	**ft²**
Array slope	**18/30**	**° (Degrees)**
Array azimuth (South=0)	**0**	**° (Degrees)**

Table 10: Parameters input to PV F-Chart for Denver

Element	Amount	Units
Floors	**1**	
Large side (floor plan)	**100**	**ft²**
Width side (floor plan)	**50**	**ft²**
Area of floor plan	**5,000**	**ft²**
Total Area of building	**5,000**	**ft²**
City	**Boulder**	
Cell Temperature (NOCT conditions)	**0.5**	**°F**
Array reference efficiency	**0.15**	
Array reference temperature	**82.4**	**°F**
Array temperature coefficient*1000	**2.389**	**1/°F**
Power tracking efficiency	**0.9**	
Power conditioning efficiency	**0.88**	
% Standard deviation of load	**0**	**%**
Array area (no. of panels X panel area)	**96**	**ft²**
Array slope	**18/40**	**° (Degrees)**
Array azimuth (South=0)	**0**	**° (Degrees)**

Figure 25 and Figure 26 show the results for the on-site solar electric energy generated for Houston, while Figure 27and Figure 28 show the results for the on-site solar electric energy generated for Denver. The output has monthly results in kW-hrs. ("*Solar*", "*Load,* "*Excess and*" "*Buy*") and *percentage (*"*Efficiency*" *and* "*f*") for the following elements:

1) "*Solar"* is the total solar radiation incidence on the flat-plate array surface,
2) "*Efficiency"* is the percent of the solar radiation incident on the flat-late array that is convert to electrical energy,
3) "*Load"* is the total electrical demand on the system,
4) 4) *f* is the percent of the load supplied directly by the flat-plate array,
5) 5) "*Excess"* is the total electrical energy that is dissipated from the system and
6) 6) "*Buy"* is the total electrical energy that should be purchased from the utility to complement the load.

The *"Dhw"* column will be used for the final results graph.

System Performance Results

Summary | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

	Solar [kW-hrs]	Efficiency [%]	Load [kW-hrs]	f [%]	Excess [kW-hrs]	Buy [kW-hrs]
Jan	20076.8	14.73	0.0	100.0	2601.9	0.0
Feb	22186.9	14.79	0.0	100.0	2886.8	0.0
Mar	28816.8	14.70	0.0	100.0	3726.5	0.0
Apr	31227.8	14.53	0.0	100.0	3992.4	0.0
May	34642.0	14.33	0.0	100.0	4367.1	0.0
Jun	35273.2	14.17	0.0	100.0	4397.1	0.0
Jul	36311.1	14.13	0.0	100.0	4514.7	0.0
Aug	35437.2	14.20	0.0	100.0	4427.7	0.0
Sep	31508.2	14.29	0.0	100.0	3963.5	0.0
Oct	30130.3	14.50	0.0	100.0	3843.3	0.0
Nov	22365.8	14.55	0.0	100.0	2864.6	0.0
Dec	19155.2	14.57	0.0	100.0	2456.0	0.0

Figure 25: Final results from PV F-Chart for Houston (Array slope = 18°)

System Performance Results

Summary | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

	Solar [kW-hrs]	Efficiency [%]	Load [kW-hrs]	f [%]	Excess [kW-hrs]	Buy [kW-hrs]
Jan	21483.6	15.03	0.0	100.0	2841.1	0.0
Feb	23203.7	14.96	0.0	100.0	3054.6	0.0
Mar	29031.2	14.76	0.0	100.0	3769.7	0.0
Apr	30423.6	14.49	0.0	100.0	3878.2	0.0
May	32745.3	14.19	0.0	100.0	4088.0	0.0
Jun	32898.6	13.98	0.0	100.0	4047.9	0.0
Jul	34080.6	13.97	0.0	100.0	4188.6	0.0
Aug	34105.1	14.12	0.0	100.0	4236.3	0.0
Sep	31405.5	14.32	0.0	100.0	3957.5	0.0
Oct	31401.6	14.64	0.0	100.0	4045.6	0.0
Nov	23894.9	14.84	0.0	100.0	3119.9	0.0
Dec	20661.0	14.90	0.0	100.0	2709.4	0.0

Figure 26: Final results from PV F-Chart for Houston (Array slope = 30°)

	Solar [kW-hrs]	Efficiency [%]	Load [kW-hrs]	f [%]	Excess [kW-hrs]	Buy [kW-hrs]
Jan	21252.1	15.06	0.0	100.0	2815.8	0.0
Feb	23620.6	15.33	0.0	100.0	3187.2	0.0
Mar	31986.9	15.38	0.0	100.0	4328.2	0.0
Apr	36255.5	15.25	0.0	100.0	4864.4	0.0
May	39510.2	14.97	0.0	100.0	5205.5	0.0
Jun	41513.6	14.70	0.0	100.0	5368.8	0.0
Jul	42381.7	14.53	0.0	100.0	5417.7	0.0
Aug	39437.9	14.59	0.0	100.0	5064.6	0.0
Sep	34151.7	14.76	0.0	100.0	4436.6	0.0
Oct	29639.3	14.96	0.0	100.0	3901.9	0.0
Nov	21910.9	14.89	0.0	100.0	2871.7	0.0
Dec	19542.4	14.91	0.0	100.0	2563.9	0.0

Figure 27: Final results from PV F-Chart for Denver (Array slope = 18°)

	Solar [kW-hrs]	Efficiency [%]	Load [kW-hrs]	f [%]	Excess [kW-hrs]	Buy [kW-hrs]
Jan	26435.9	15.97	0.0	100.0	3715.6	0.0
Feb	27183.3	15.92	0.0	100.0	3808.8	0.0
Mar	33818.6	15.61	0.0	100.0	4646.9	0.0
Apr	35519.2	15.25	0.0	100.0	4767.6	0.0
May	36301.5	14.79	0.0	100.0	4723.4	0.0
Jun	37098.9	14.45	0.0	100.0	4717.6	0.0
Jul	38396.0	14.31	0.0	100.0	4835.6	0.0
Aug	37650.0	14.52	0.0	100.0	4810.5	0.0
Sep	35156.9	14.91	0.0	100.0	4614.1	0.0
Oct	33476.1	15.44	0.0	100.0	4547.0	0.0
Nov	26695.2	15.72	0.0	100.0	3692.9	0.0
Dec	24813.4	15.89	0.0	100.0	3470.4	0.0

Figure 28: Final results from PV F-Chart for Denver (Array slope = 40°)

3.6 Analysis through Revit BIM Model

This current BIM-Model will be used later for later phases of the research process. The BIM-Model of the complex building was generated for Houston and Denver after creating the model into DOE-2.1e. The days of the renderings correspond to the design days used in DOE-2.1e for summer and winter. The days chosen were: August 9th (summer) and January 14th (winter) for Houston, and August 25th (summer) and February 3rd (winter) for Denver. The building shows the different features from the DOE-2.1e Model: Trombé wall (that was finally removed from the DOE-2.1e Model, because of the low energy-efficiency results), south windows, clerestory and photovoltaic. This BIM-Model is still in process.

4 WHOLE BUILDING SIMULATION ANALYSES

This section shows the graphs with the final monthly results from the DOE-2.1e, F-Chart and PV F-Chart simulations for the office building in Houston and Denver. Table 11 and Table 12 show the results for Houston, while Table 13and Table 14 show the results for Denver. The PV array slope in Tables 11 and 13 is 18° for both Houston and Denver. The slope of the PV array matches the slope of the southern roof. Table 12 uses the PV array slope of 30° for Houston, and Table 14 uses PV array slope of 40° for Denver. The following results are taken from the PS-E report from DOE-2.1e and used in the Tables 11, 12, 13 and 14: *"Lighting", "Equipment", "Heating", "Cooling", "Pumps & Misc.", "Vent. Fans" and "DHW".* The *"Thermal Load (Heating + DHW)"* column is the sum of the *"Heating"* and *"DHW"* columns. The *"Electric only (No Heating + No DHW)"* column is the sum of the *"Lighting", "Equipment", "Cooling", "Pumps & Misc." and "Vent. Fans"* columns. The *"Total"* column is the sum of the *"Thermal Load (Heating + DHW)"* and the *"Electric only (No Heating + No DHW)"* columns. This last column has the total monthly energy consumption of the office building simulated through DOE-2.1e.

The last three columns of the table are the following: *"Energy Available from Collector"*, *"Energy Available from PV" and "Total Energy Available".* The first column is the solar thermal energy simulated through the F-Chart. The second column is the solar electric energy simulated through the PV F-Chart. The final column is the sum of the previous two columns and represents the total monthly on-site energy produced through solar collectors and photovoltaic. Figures 29 to 36 show the graphs with the data from Tables 11 to 14. Each month has two stack columns. The left column has the following data: *"Lighting", "Equipment", "Heating", "Cooling", "Pumps & Misc.", "Vent. Fans" and "DHW".* The right column has the following data: *"Energy Available from Collector"* and *"Energy Available from PV".*

Figures 29 and 31 show the graphs with the results for Houston. Figure 29 shows a big on-site energy produced during the summer months compared to the January-February and November-December periods. Houston is located at 30°N and this angle is commonly used for solar and energy calculation purposes. If the PV array slope is changed from 18° to 30°, the on-site energy results will change. Figure 31 shows a reduction of on-site energy produced during the summer months and an increase of on-site energy produced during the January-February and November-December periods. The energy consumed in the office building in Houston is high in January, February, the summer months, September, October and December. Figures 33 and 35 show the graphs with the results for Denver. Figure 33 shows that a big on-site energy was produced in the March-September period compared to January, November and December. Denver is located at 40°N and this angle is commonly used for solar and energy calculation purposes. If the PV array slope is changed from 18° to 40°, like it was done for Houston, the on-site energy results will change. Figure 35 shows a reduction of on-site energy produced during March-September period and an increase of on-site energy produced during the January-February and November-December periods. The energy consumed in the office building in Denver is high in January, February, March, November and December.

Figures 30 and 32 show the graphs with the annual results for Houston. Figure 30 shows the energy consumed in the office building in the first column. The second column is the result of the F-Chart and the PV F-Chart programs for the harvested on-site energy from the use of the Domestic Hot Water, and the 18° slope of the Photovoltaic Array, respectively. The final result shows that there is an excess of 2 percent of harvested on-site energy over the consumed energy of the office building. Figure 32 shows the energy consumed in the office building in the first column. The second column is the result of the F-Chart and the PV F-Chart programs for the harvested on-site energy from the use of the Domestic Hot Water, and the 30° slope of the Photovoltaic Array, respectively. The final result shows that there is an excess of 1 percent of harvested on-site energy over the consumed energy of the office building.

Figures 34 and 36 show the graphs with the annual results for Denver. Figure 34 shows the energy consumed in the office building in the first column. The second column is the result of the F-Chart and the PV F-Chart programs for the harvested on-site energy from the use of the Domestic Hot Water, and the 18° slope of the Photovoltaic Array, respectively. The final result shows that there is an excess of 2.5 percent of harvested on-site energy over the consumed energy of the office building. Figure 36 shows the energy consumed in the office building in the first column. The second column is the result of the F-Chart and the PV F-Chart programs for the harvested on-site energy from the use of the Domestic Hot Water, and the 40° slope of the Photovoltaic Array, respectively. The final result shows that there is an excess of 6.5 percent of harvested on-site energy over the consumed energy of the office building.

Table 11: Final Energy Consumption results for the Solar Office Building in Houston (PV Solar Array slope = 18°)

Energy Needed (from PS-E, DOE-2.1e output)											F-Chart	PV F-Chart	
	Lighting	Equipment	Heating	Cooling	Pump. & Misc.	Vent. Fans	DHW	Thermal Load (Heating + DHW)	Electric Only (No Heating + No DHW)	TOTAL	Energy Available from Collector	Energy Available from PV	Total Energy Available
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Jan	734	1,088	892	1,021	186	233	421	1,313	3,262	4,575	691	2,602	3,293
Feb	593	999	910	874	168	213	392	1,302	2,847	4,149	621	2,887	3,507
Mar	626	1,140	69	1,193	186	235	435	504	3,380	3,884	666	3,727	4,392
Apr	437	1,098	0	1,426	180	228	415	415	3,369	3,784	609	3,992	4,602
May	361	1,088	0	1,801	186	239	405	405	3,675	4,080	590	4,367	4,957
Jun	305	1,098	0	2,185	180	244	368	368	4,012	4,380	541	4,397	4,938
Jul	343	1,105	0	2,427	186	259	360	360	4,320	4,680	537	4,515	5,052
Aug	246	1,122	0	2,338	186	259	346	346	4,151	4,497	541	4,428	4,968
Sep	364	1,081	0	2,093	180	251	334	334	3,969	4,303	545	3,964	4,509
Oct	398	1,088	0	1,742	186	247	356	356	3,661	4,017	599	3,843	4,442
Nov	575	1,064	16	1,329	180	229	364	380	3,377	3,757	619	2,865	3,483
Dec	903	1,105	593	964	186	233	400	993	3,391	4,384	669	2,456	3,125
Year	5,886	13,077	2,480	19,391	2,184	2,869	4,597	7,077	43,407	50,484	7,228	44,042	51,270

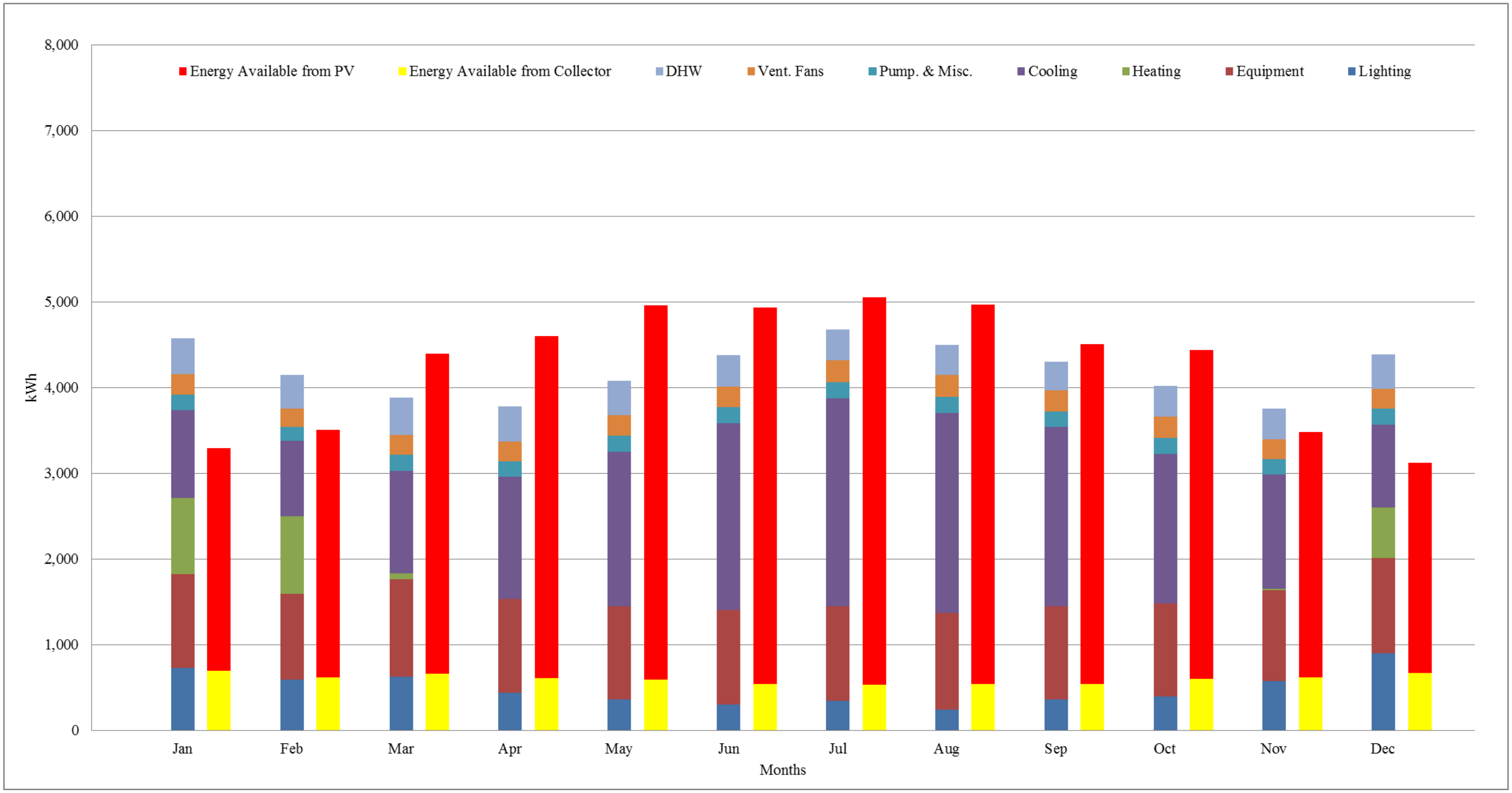


Figure 29: Final Energy Consumption results for the Solar Office Building in Houston (PV Solar Array slope = 18°)

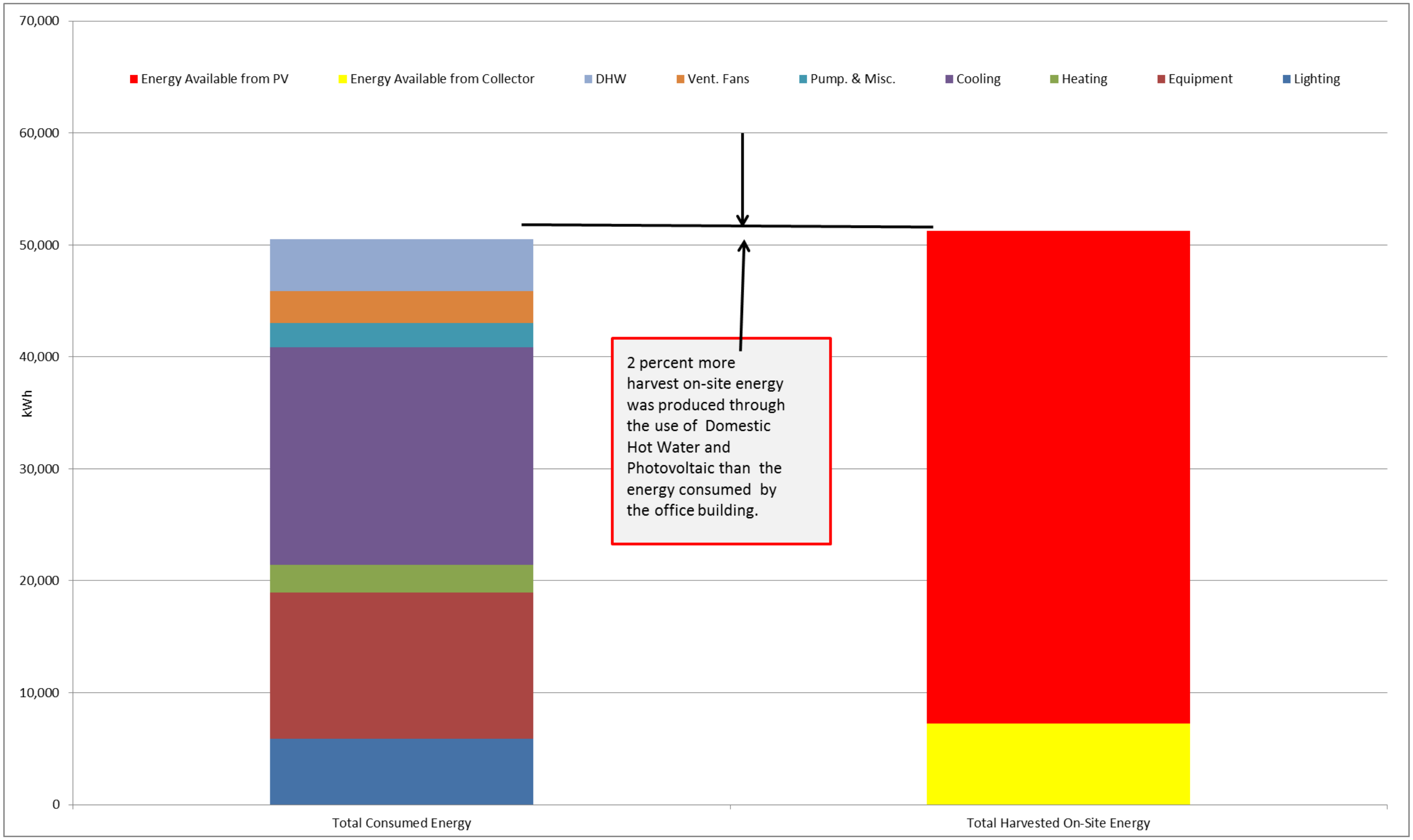


Figure 30: Final Total Annual Energy Consumption results for the Solar Office Building in Houston (PV Solar Array slope = 18°)

Table 12: Final Energy Consumption results for the Solar Office Building in Houston (PV Solar Array slope = 30°)

Energy Needed (from PS-E, DOE-2.1e output)											F-Chart	PV F-Chart	
	Lighting	Equipment	Heating	Cooling	Pump. & Misc.	Vent. Fans	DHW	Thermal Load (Heating + DHW)	Electric Only (No Heating + No DHW)	TOTAL	Energy Available from Collector	Energy Available from PV	Total Energy Available
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Jan	734	1,088	892	1,021	186	233	421	1,313	3,262	4,575	691	2,841	3,533
Feb	593	999	910	874	168	213	392	1,302	2,847	4,149	621	3,055	3,675
Mar	626	1,140	69	1,193	186	235	435	504	3,380	3,884	666	3,770	4,435
Apr	437	1,098	0	1,426	180	228	415	415	3,369	3,784	609	3,878	4,488
May	361	1,088	0	1,801	186	239	405	405	3,675	4,080	590	4,088	4,678
Jun	305	1,098	0	2,185	180	244	368	368	4,012	4,380	541	4,048	4,589
Jul	343	1,105	0	2,427	186	259	360	360	4,320	4,680	537	4,189	4,726
Aug	246	1,122	0	2,338	186	259	346	346	4,151	4,497	541	4,236	4,777
Sep	364	1,081	0	2,093	180	251	334	334	3,969	4,303	545	3,958	4,503
Oct	398	1,088	0	1,742	186	247	356	356	3,661	4,017	599	4,046	4,645
Nov	575	1,064	16	1,329	180	229	364	380	3,377	3,757	619	3,120	3,738
Dec	903	1,105	593	964	186	233	400	993	3,391	4,384	669	2,709	3,378
Year	5,886	13,077	2,480	19,391	2,184	2,869	4,597	7,077	43,407	50,484	7,228	43,937	51,165

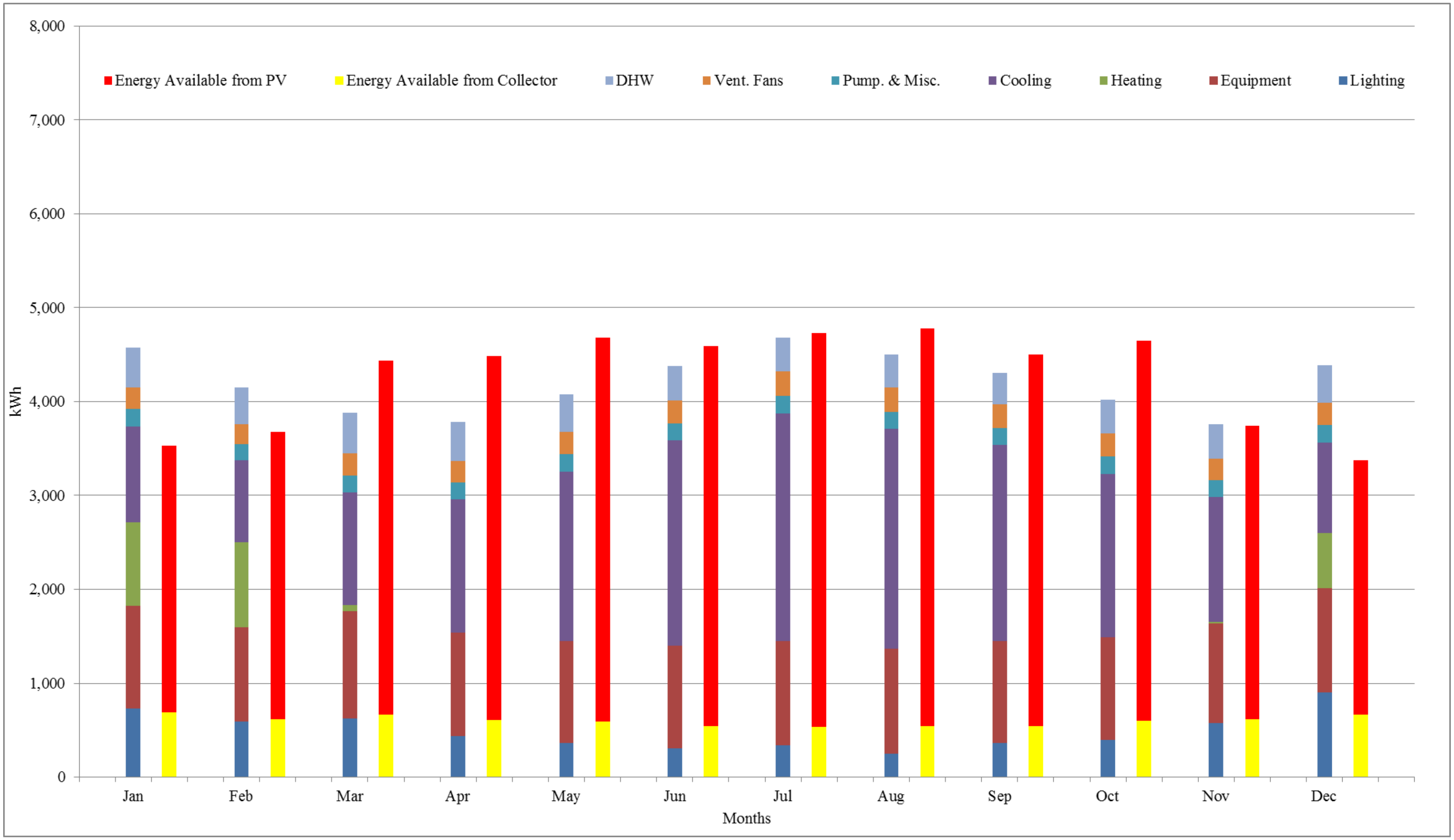


Figure 31: Final Energy Consumption results for the Solar Office Building in Houston (PV Solar Array slope = 30°)

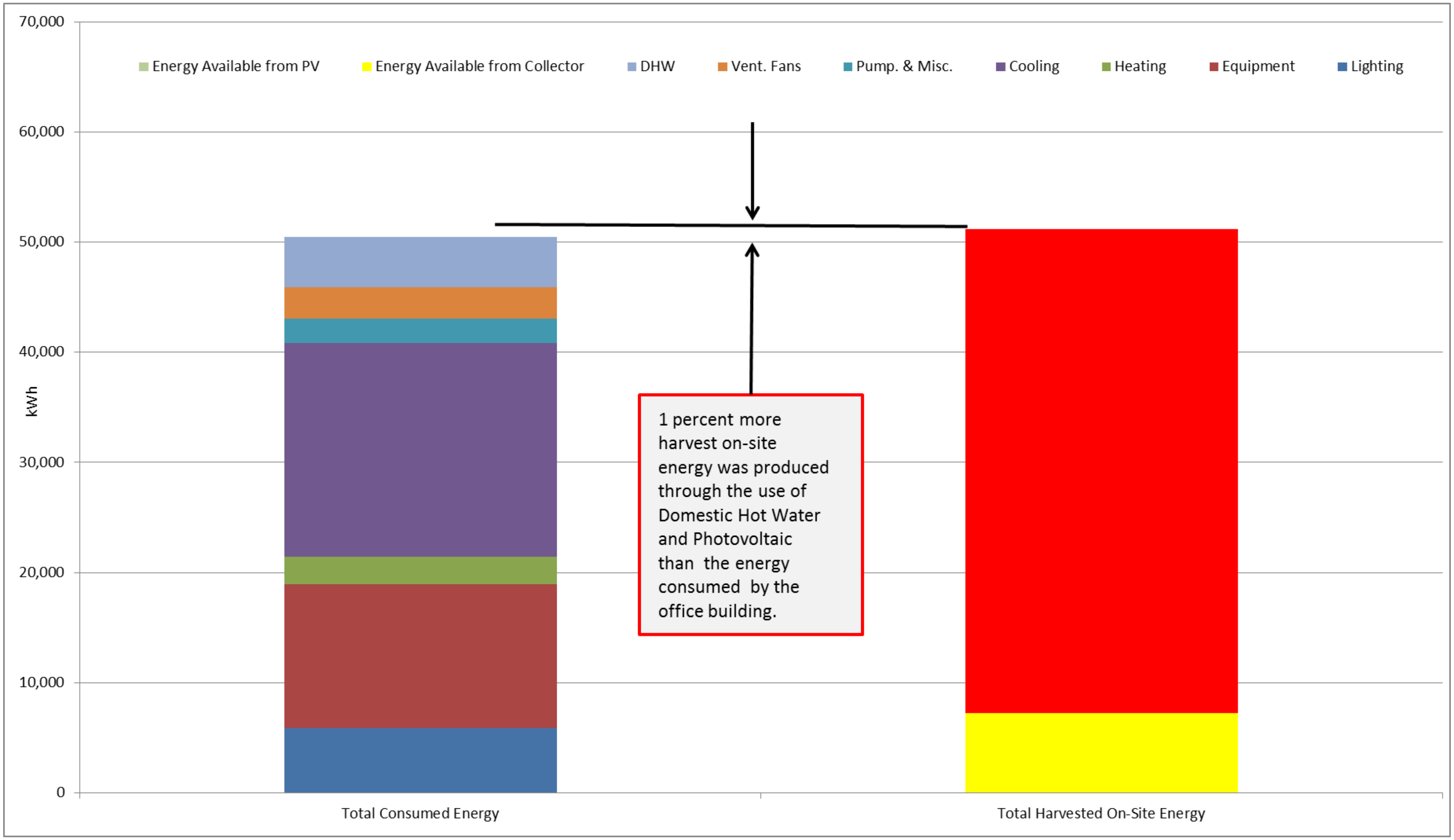


Figure 32: Final Total Annual Energy Consumption Results for the Solar Office Building in Houston (PV Solar Array Slope = 30°)

Table 13: Final Energy Consumption results for the Solar Office Building in Denver (PV Solar Array slope = 18°)

	Energy Needed (from PS-E, DOE-2.1e output)										F-Chart	PV F-Chart	
	Lighting	Equipment	Heating	Cooling	Pump. & Misc.	Vent. Fans	DHW	Thermal Load (Heating + DHW)	Electric Only (No Heating + No DHW)	TOTAL	Energy Available from Collector	Energy Available from PV	Total Energy Available
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Jan	548	1,088	3,396	784	196	233	535	3,931	2,849	6,780	807	2,816	3,622
Feb	450	999	2,778	750	177	211	499	3,277	2,587	5,864	734	3,187	3,921
Mar	433	1,140	1,886	828	196	233	554	2,440	2,830	5,270	803	4,328	5,131
Apr	307	1,098	855	873	189	226	528	1,383	2,693	4,076	752	4,864	5,616
May	272	1,088	395	1,041	196	233	511	906	2,830	3,736	742	5,206	5,948
Jun	369	1,098	23	1,331	189	227	460	483	3,214	3,697	689	5,369	6,057
Jul	333	1,105	0	1,904	196	245	445	445	3,783	4,228	682	5,418	6,100
Aug	287	1,122	0	1,760	196	247	426	426	3,612	4,038	674	5,065	5,739
Sep	260	1,081	56	1,428	189	233	411	467	3,191	3,658	663	4,437	5,100
Oct	372	1,088	372	1,125	196	238	440	812	3,019	3,831	711	3,902	4,613
Nov	653	1,064	1,709	808	189	226	454	2,163	2,940	5,103	722	2,872	3,593
Dec	664	1,105	3,552	792	196	233	504	4,056	2,990	7,046	776	2,564	3,339
Year	4,950	13,077	15,022	13,425	2,305	2,785	5,768	20,790	36,542	57,332	8,755	50,026	58,781

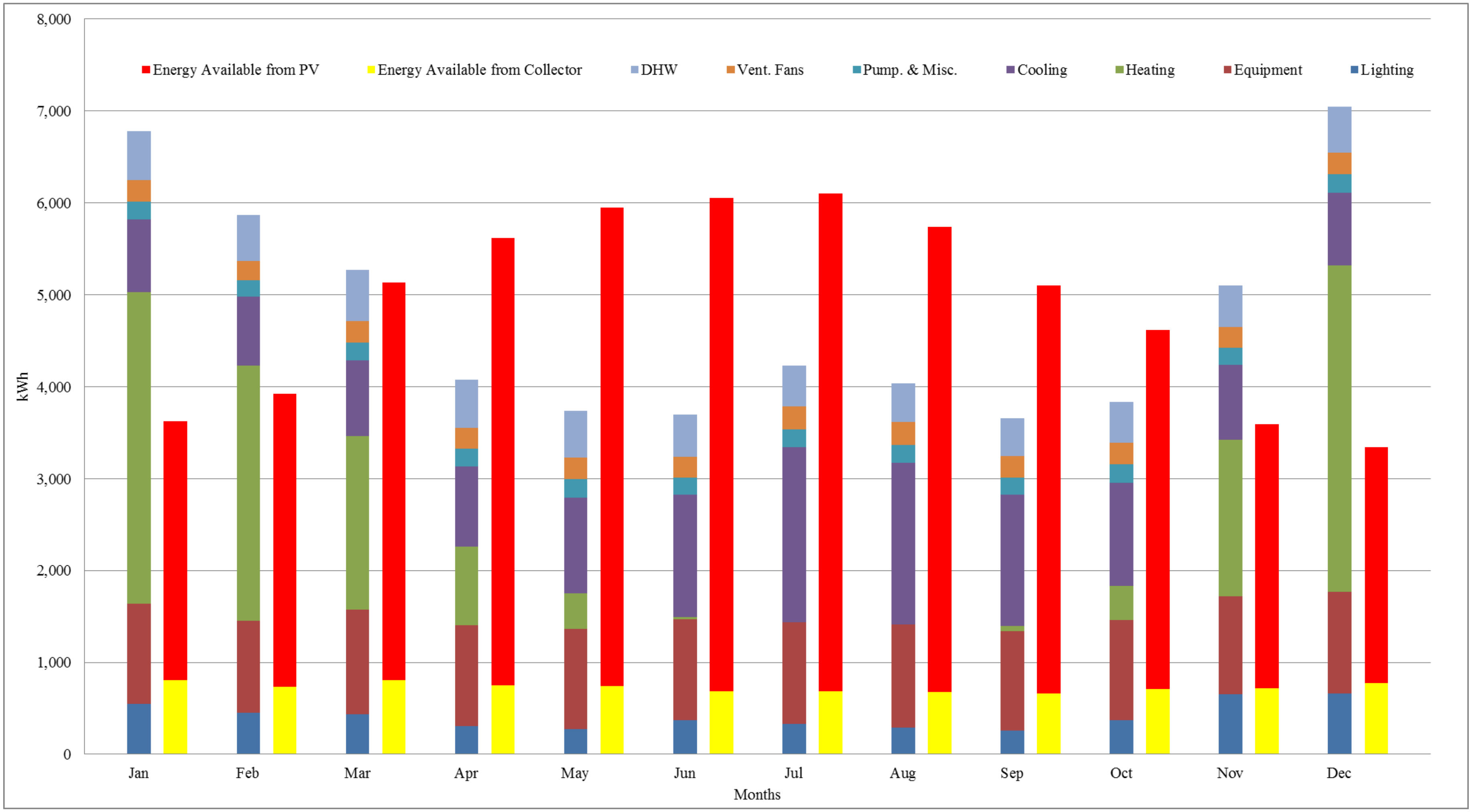


Figure 33: Final Energy Consumption results for the Solar Office Building in Denver (PV Solar Array slope = 18°)

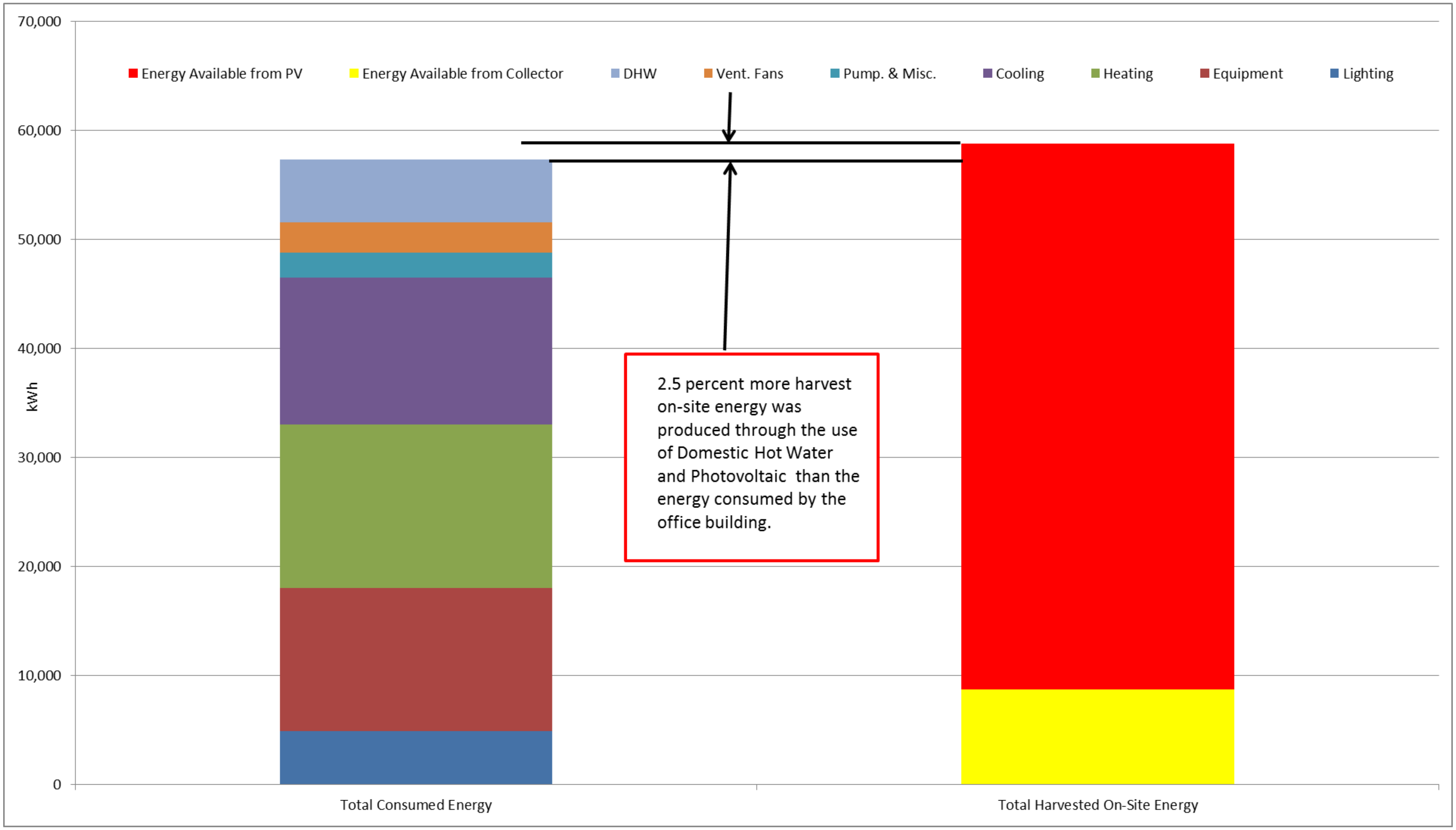


Figure 34: Final Total Annual Consumption results for the Solar Office Building in Denver (PV Solar Array Slope = 18°

Table 14: Final Energy Consumption results for the Solar Office Building in Denver (PV Solar Array slope = 40°)

	Energy Needed (from PS-E, DOE-2.1e output)										F-Chart	PV F-Chart	
	Lighting	Equipment	Heating	Cooling	Pump. & Misc.	Vent. Fans	DHW	Thermal Load (Heating + DHW)	Electric Only (No Heating + No DHW)	TOTAL	Energy Available from Collector	Energy Available from PV	Total Energy Available
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Jan	548	1,088	3,396	784	196	233	535	3,931	2,849	6,780	807	3,716	4,522
Feb	450	999	2,778	750	177	211	499	3,277	2,587	5,864	734	3,809	4,543
Mar	433	1,140	1,886	828	196	233	554	2,440	2,830	5,270	803	4,647	5,450
Apr	307	1,098	855	873	189	226	528	1,383	2,693	4,076	752	4,768	5,519
May	272	1,088	395	1,041	196	233	511	906	2,830	3,736	742	4,723	5,466
Jun	369	1,098	23	1,331	189	227	460	483	3,214	3,697	689	4,718	5,406
Jul	333	1,105	0	1,904	196	245	445	445	3,783	4,228	682	4,836	5,517
Aug	287	1,122	0	1,760	196	247	426	426	3,612	4,038	674	4,811	5,485
Sep	260	1,081	56	1,428	189	233	411	467	3,191	3,658	663	4,614	5,277
Oct	372	1,088	372	1,125	196	238	440	812	3,019	3,831	711	4,547	5,258
Nov	653	1,064	1,709	808	189	226	454	2,163	2,940	5,103	722	3,693	4,415
Dec	664	1,105	3,552	792	196	233	504	4,056	2,990	7,046	776	3,470	4,246
Year	4,950	13,077	15,022	13,425	2,305	2,785	5,768	20,790	36,542	57,332	8,755	52,351	61,105

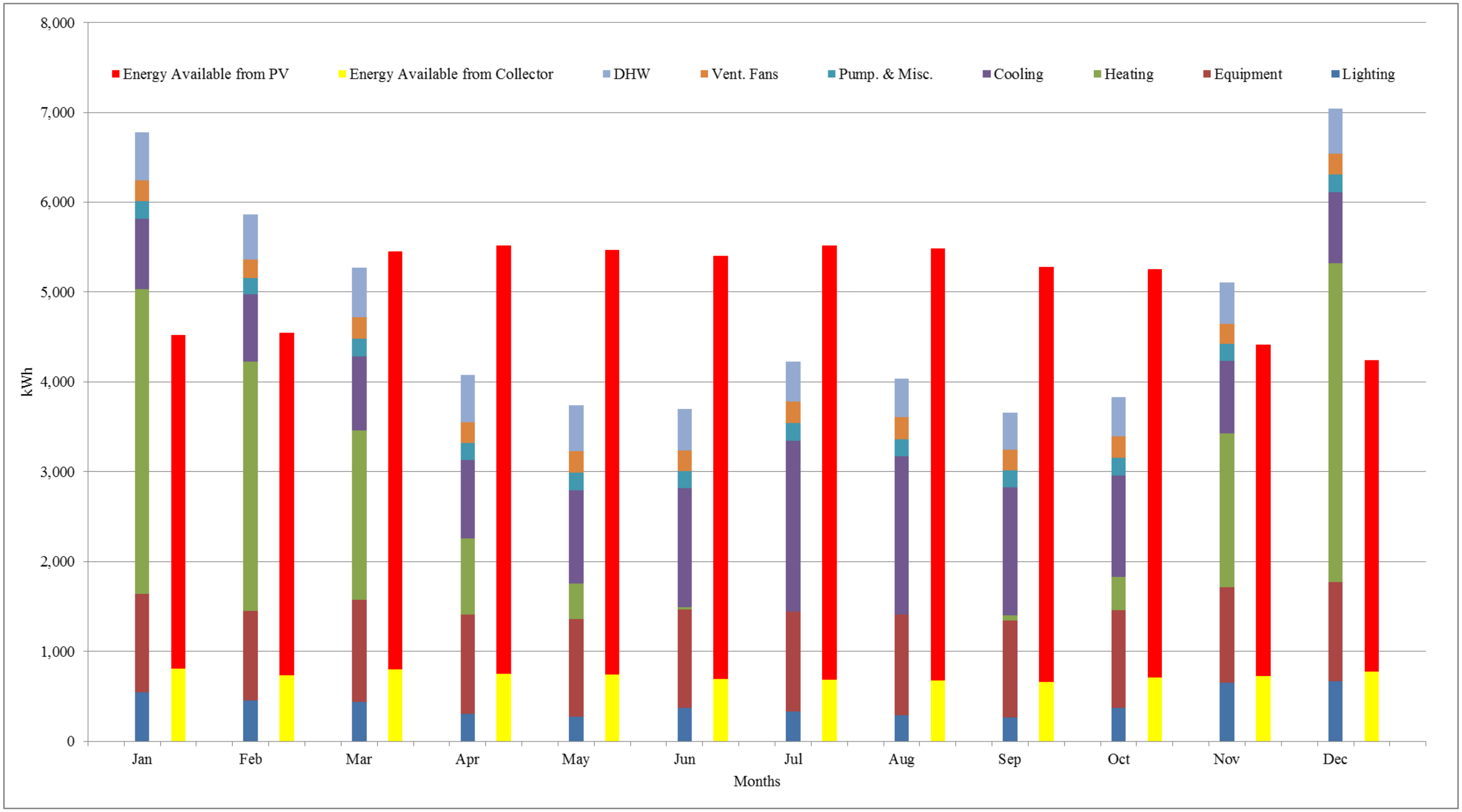


Figure 35: Final Energy Consumption results for the Solar Office Building in Denver (PV Solar Array slope = 40°)

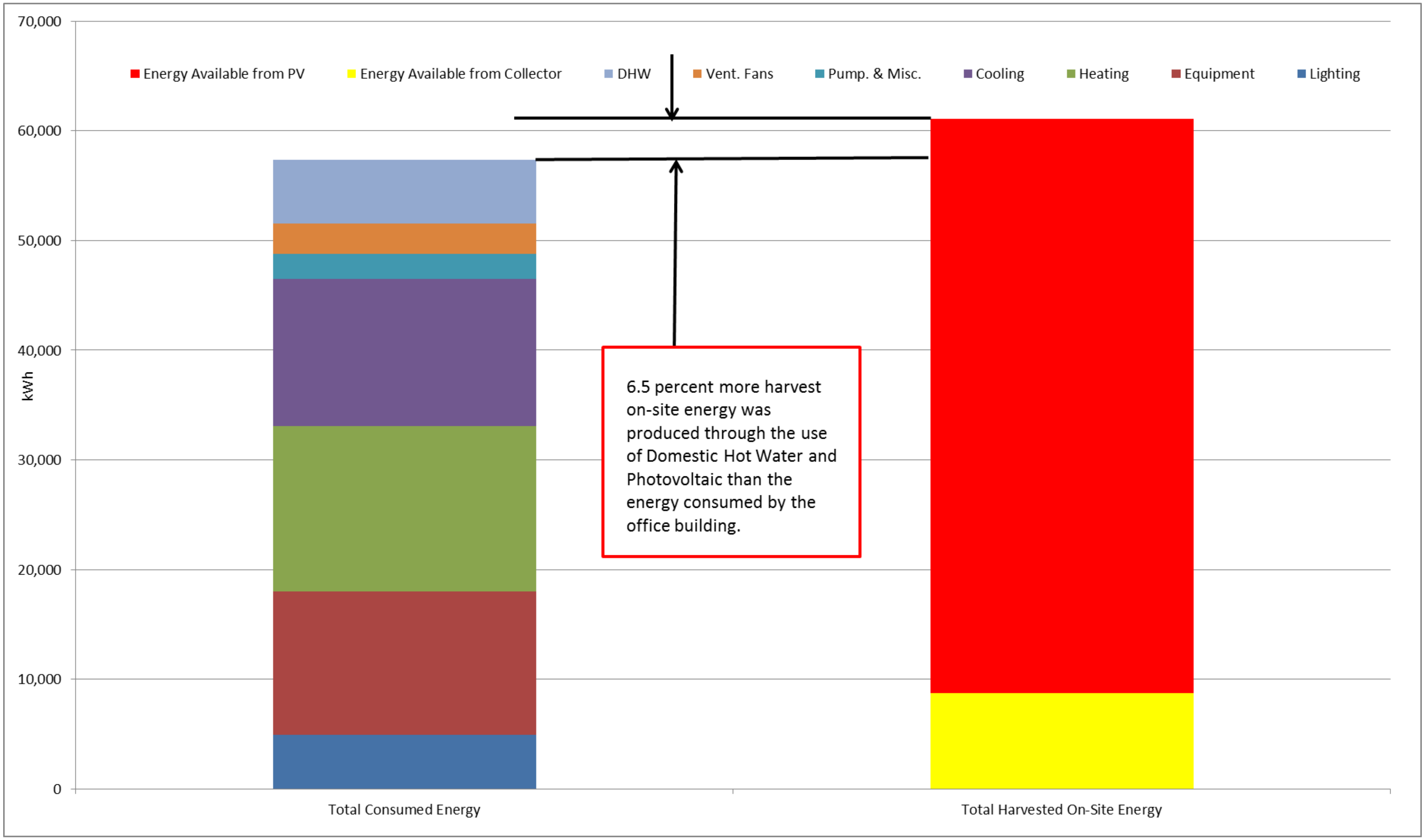


Figure 36: Final Total Annual Energy Consumption results for the Solar Office Building in Denver (PV Solar Array slope = 40°)

The BIM-Model of the complex building was generated for Houston and Denver after creating the model into DOE-2.1e. The days of the renderings correspond to the design days used in DOE-2.1e for summer and winter. The days chosen were: August 9th (summer) and January 14th (winter) for Houston, and August 25th (summer) and February 3rd (winter) for Denver. There are some elements missing (i.e. the building lifted in the air on columns from the first two cases) that were used in the DOE-2.1e Model.

1) The building was lifted 10 ft. in the air to avoid the heat transfer with the ground. This basecase did not have a floor, windows, doors, infiltration or lighting. We try to validate the U-Value of the walls and roofs through code compliance, and the validation of the steady-state “q” through manual calculation only with the envelope.
2) We placed a floor to the building and validated the heating consumption by increasing the size of the floor.
3) The previous two points were entirely done through DOE-2.1e (thermal simulations) and DrawBDL Processor (3D-Modeling). This approach gave us the feedback to do the Revit Model of the Complex Office Building.
4) We put the building over the site. This time the building has floor, walls and roofs, but it still does not have any windows, doors, people, infiltration or lighting (see Figure 37). Due to the latitude, the shadow casted in summer on the walls in Denver is shorter than the shadow casted in Houston (Figures. 37a and 37b). On the other hand, the shadow cast for the winter season seems similar for Houston and Denver (Figures 37c and 37d). But, there is a small shadow near the edge of the upper side of the upper wall in Houston. The shadow cast in Denver is shorter than Houston.

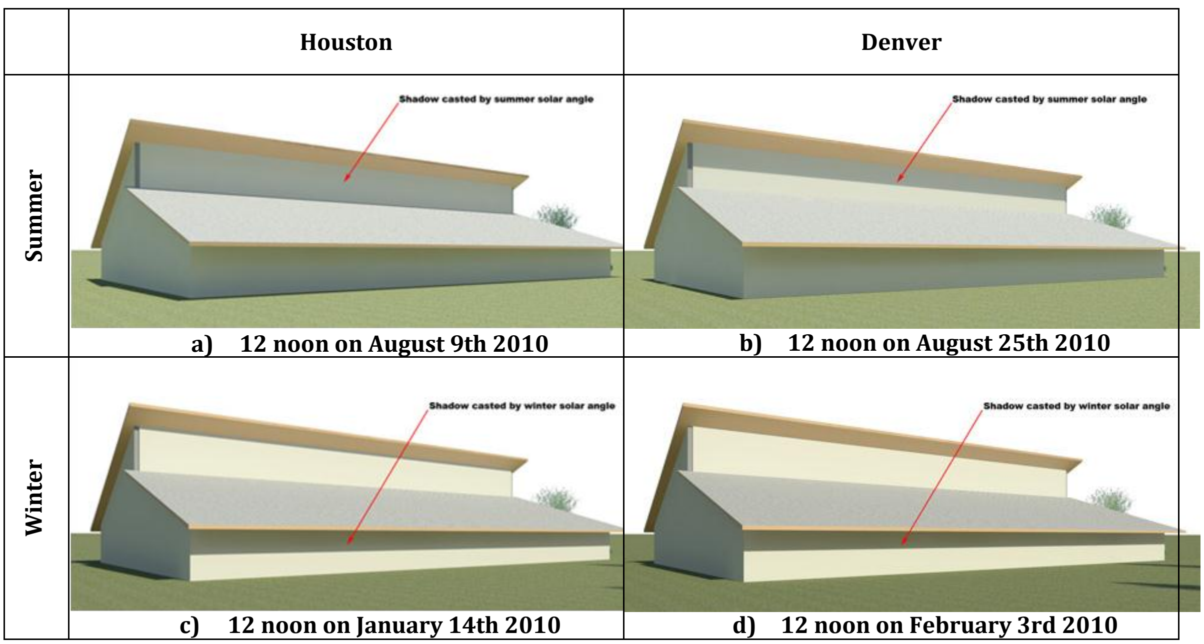


Figure 37: BIM Office Building Model without any features

5) In Figure 38 we will start the development of high performance buildings using wise approach features applied to the basic model one by one:

5.1) Eight inch concrete block Trombé wall with four inch channel width and a single clear pane window. The Trombé wall is a passive solar feature that has to be protected during the summer (Figures 38a and 38b). There are some openings that will allow cold air to push out the hot air from the interior. On the other hand, the Trombé wall during the winter will re-irradiate the heat accumulated during the day to the interior space during the night (Figures 38c and 38d). Therefore, the sun needs to strike it during the winter.

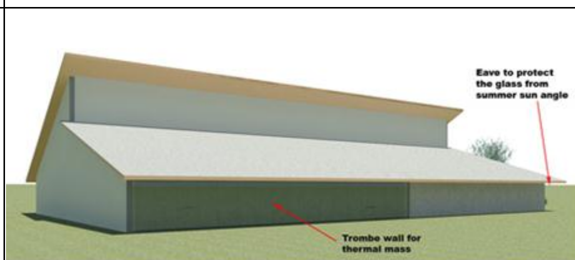
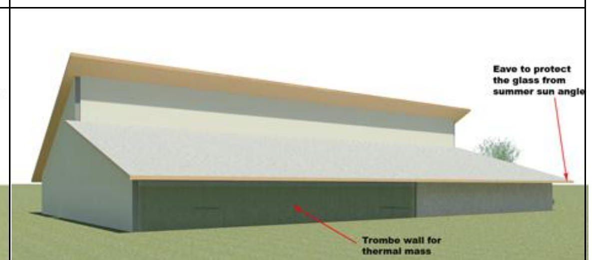
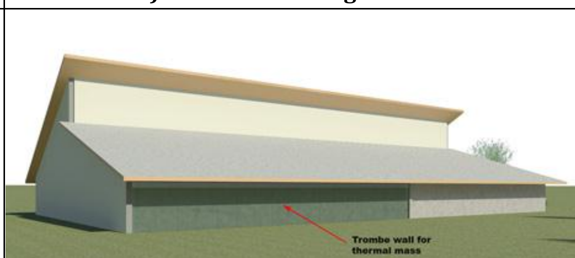
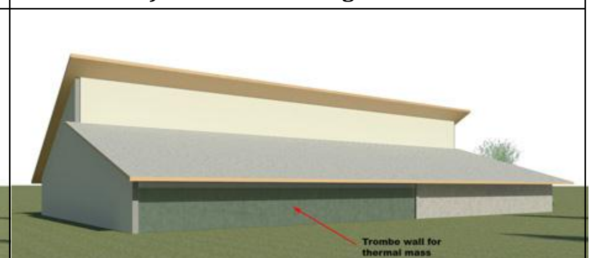
	Houston	Denver
Summer	 **a) 12 noon on August 9th 2010**	 **b) 12 noon on August 25th 2010**
Winter	 **c) 12 noon on January 14th 2010**	 **d) 12 noon on February 3rd 2010**

Figure 38: High Performance Building over the site with Trombé Wall

5.2) In Figure 39 a 4 ft. X 45 ft. double clear pane window near the east side on the lower south wall. The window is covered by an eave. The eave protects the south windows from the summer solar angle. This will avoid the solar access and the increase of the temperature in the interior space (Figures 39a and 39b). On the other hand, we want to allow the solar access through the windows during the winter season (Figures 39c and 39d).

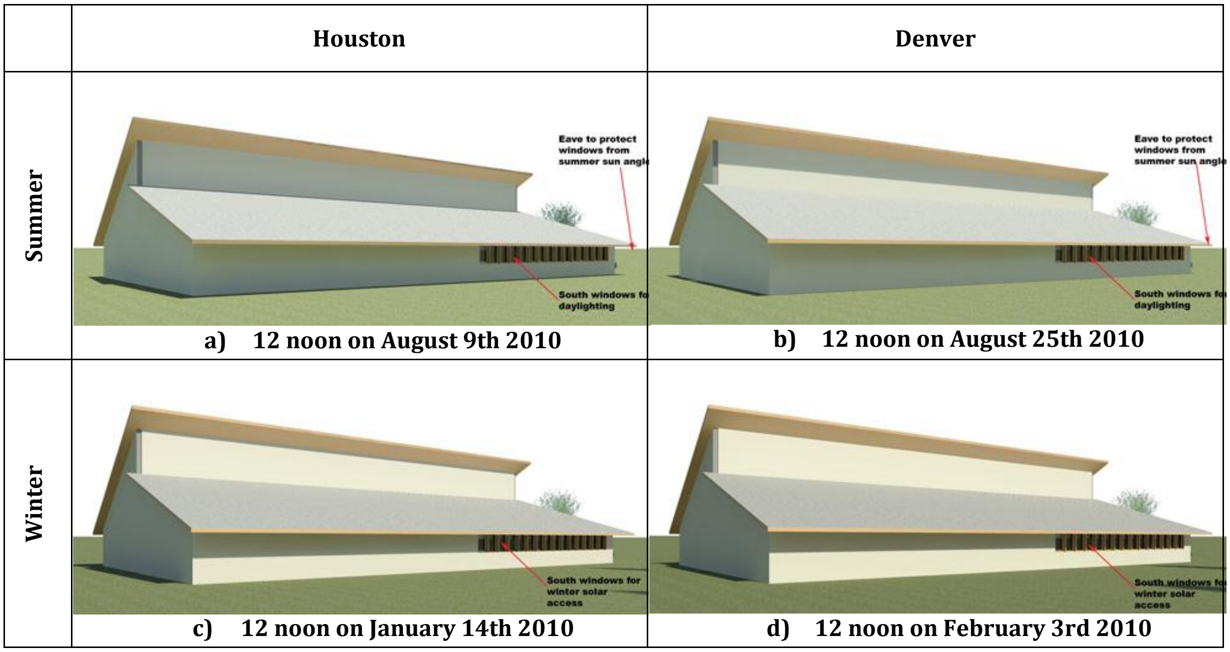


Figure 39: High Performance Building over the site with Southern Windows

5.3) Figure 40 shows two (24 ft. X 24 ft. double clear pane windows on the north wall. The reflected daylighting from the north will be introduced through these two windows (Figures. 40a and40d).

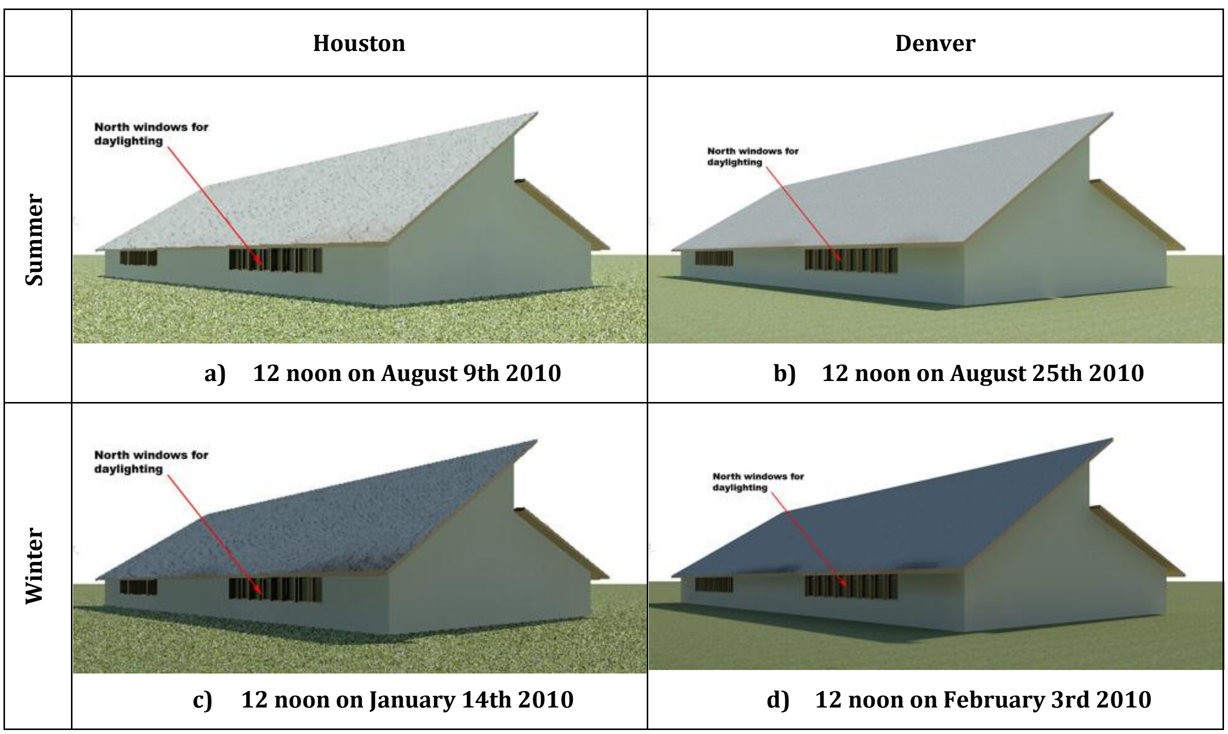


Figure 40: High Performance Building over the site with North Windows

5.4) A 3 ft. X 90 ft. double clear pane clerestory window in the upper south wall was added in Figure 41. The eave will protect the clerestory from the summer solar angle and avoid the increase of temperature in the space (Figures 41a and 41 b). The daylighting for winter will be introduced through this clerestory on the upper south wall (Figures 41c and 41d).

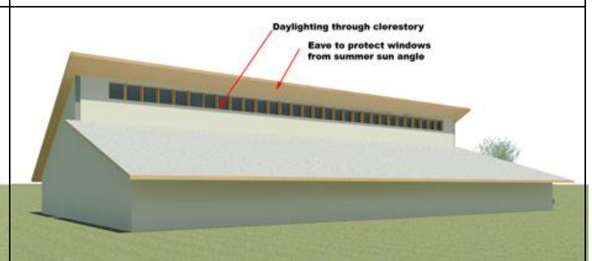
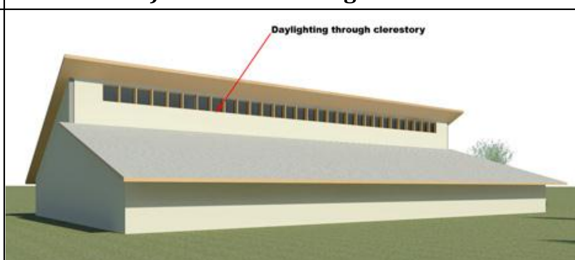
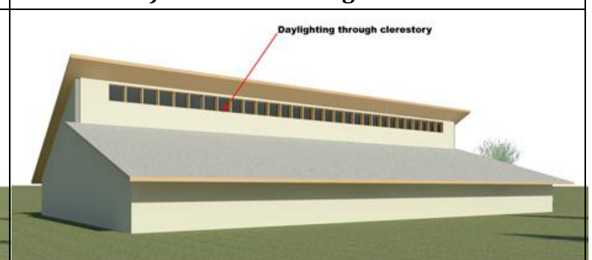
	Houston	Denver
Summer	 a) 12 noon on August 9th 2010	 b) 12 noon on August 25th 2010
Winter	 c) 12 noon on January 14th 2010	 d) 12 noon on February 3rd 2010

Figure 41: High Performance Building over the site with Clerestory

6) We combined different features at this point.
   6.1) Figure 42 shows a south window + clerestory. The eaves will protect the south windows and the clerestory from the summer solar angle (Figures 42a and 42b).

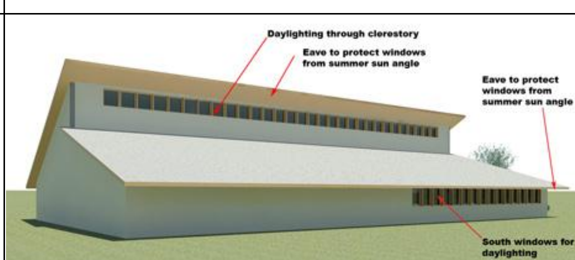
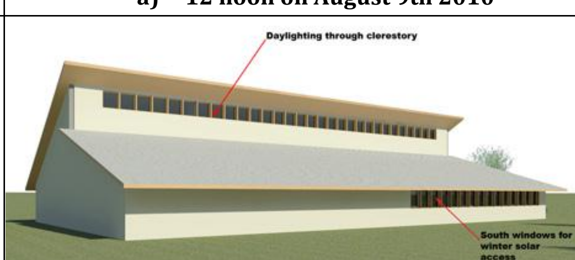
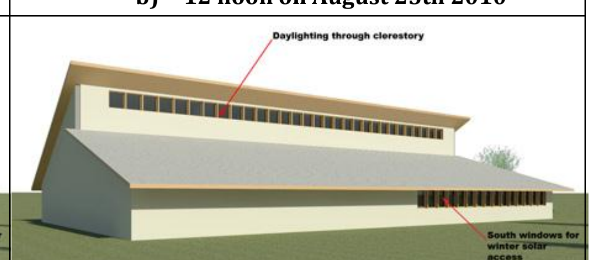
	Houston	Denver
Summer	 a) 12 noon on August 9th 2010	 b) 12 noon on August 25th 2010
Winter	 c) 12 noon on January 14th 2010	 d) 12 noon on February 3rd 2010

Figure 42: High Performance Building over the site with South Windows +Clerestory

6.2) South window + north windows + clerestory. This case is similar to the previous one plus the north windows.

6.3) Figure 43 shows a Trombé wall + south window + clerestory. The eaves will protect the Trombé wall and the south windows from the summer solar angle (Figures. 43a and43b).We try to let the solar access through the south windows and let the Trombé wall to be warm during the winter season (Figures. 43c and 43d). The Trombé wall is a passive solar feature that will re-irradiate the heat accumulated during the day to the interior space during the night.

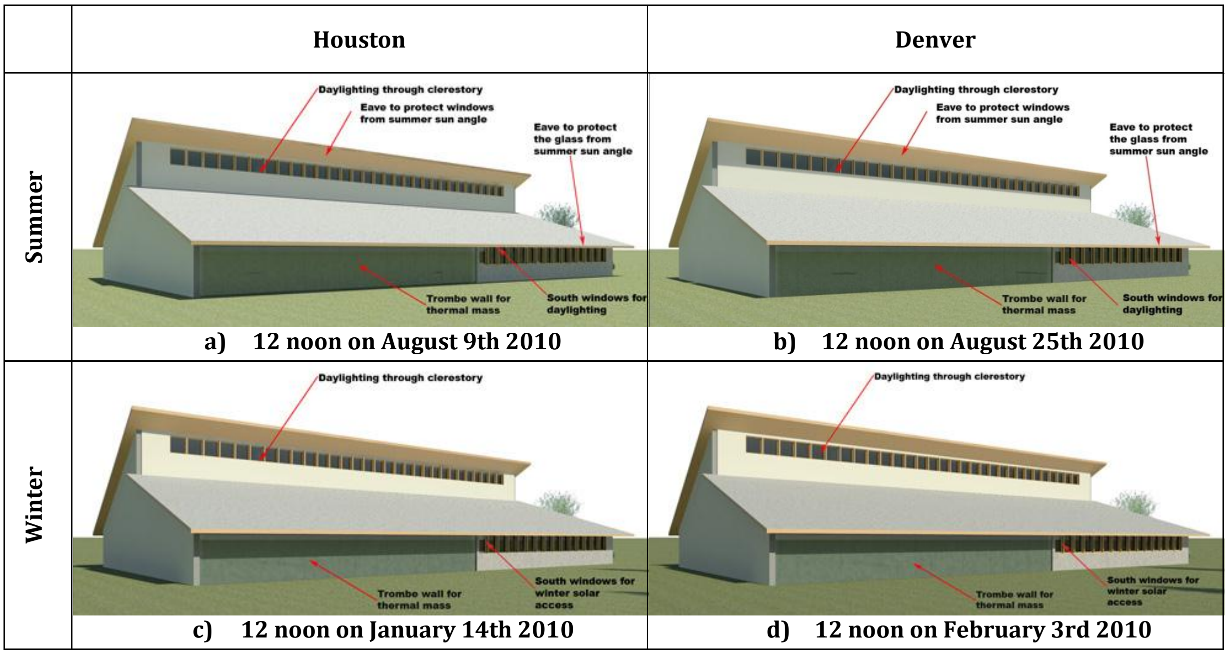


Figure 43: High Performance Building over the site with Trombé Wall + South Windows +Clerestory

6.4) Trombé wall + south window + north windows + clerestory. This case is similar to the previous one plus the north windows.

6.5) In Figure 44, we see people + Trombé wall + south window + north windows + clerestory + DHW. This case will involve the solar thermal (DHW) simulation. The solar angles of the seasons change the tilt of the photovoltaic due to the latitude of Houston (Figures 44a and 44c) and Denver (Figures 44b and 44d).

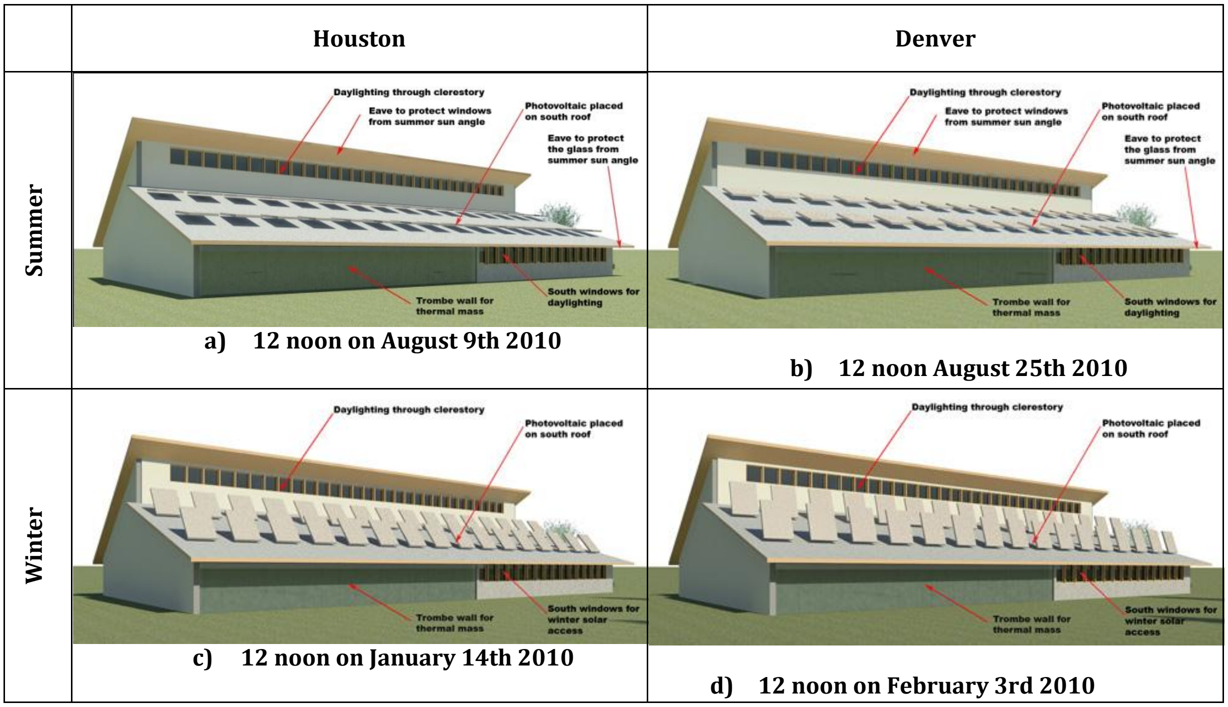


Figure 44: High Performance Building over the site with Trombé Wall + South Windows +North Windows + Clerestory + DHW

6.6) South window + north windows + clerestory + DHW. This case is similar to the previous one without people. Some reports will be used to run the solar thermal simulation and the photovoltaic in the F-Chart and PV F-Chart, respectively.
6.7) South window + north windows + clerestory + daylighting sensors. This case will involve the placement of all the windows (south, north and clerestory) and turn on the interior daylighting sensors. The sensors will dim the amount of artificial light if the natural daylighting is enough to satisfy the lighting requirements for the working places.

7) The thermal simulation results from DOE-2.1e will be placed in a series of graphs.

8) Some results from DOE-2.1e will be used to analyze and simulate solar thermal (DHW) in the F-Chart and photovoltaic (PV) in the PV F-Chart.

5 RESULTS

The results show that the high performance solar office building for the NSF-PBIM project reduced annual energy consumption by 100 percent in both Houston and Denver as compared to a regular office building. By using the legacy tools, the Net-Zero Energy Office Building produces more energy than it consumes. We used some renewable energy systems to achieve the Net-Zero Energy. The renewable energy systems used were the solar Domestic Hot Water (DHW), the photovoltaic and daylighting (clerestory windows and daylighting sensors). The combination of different renewable energy systems (solar Domestic Hot Water (DHW), clerestory windows, daylighting sensors and photovoltaic) allowed the reduction of energy consumption in both Houston and Denver. The Trombé wall was omitted for the final analysis in the legacy tools, because of the low energy savings registered during the process.

6 SUMMARY

This report, which was created for the National Science Foundation-Physical Building Information Modeling (NSF-PBIM) project at Texas A&M University, describes the analysis of a solar office building using the following software: the legacy tools (DOE 2.1e, the F-Chart and the PV-F Chart) for whole-building energy analysis, solar thermal analysis and solar electric analysis; the Revit software that was used to render the images of the solar office building and get feedback for the DOE-2.1e; and the Inverse Model Toolkit (IMT) program to transfer data between the legacy tools. This report found that the on-site energy produced through the solar passive strategies (clerestory windows and southern windows), the artificial lighting saving sensors, solar collectors (DHW) and the photovoltaic is covering most of the energy consumed by the office building throughout the year in both Houston and Denver. Therefore, the office building is Net-Zero Energy Building. The Trombé wall was omitted for the final analysis in the legacy tools, because of the low energy savings registered during the process. These analyses were run during the first two years of the National Science Foundation Physical Building Information Modeling (NSF PBIM) project at Texas A&M University.

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APPENDIX

This is the input file for Houston that uses SYSTEM-TYPE-VAVS

```
$TYPE OF BUILDING
$SAMPLE1E-RUN3A WITH MODIFICATION
$TEST CASE ONE SIX ZONE MODEL

$FILE NAME = 01A1.INP


$************************************************
********************************
$       PROGRAM:            DOE-2 SIMULATION
INPUT FILE
$
$       LANGUAGE:           DOE-2.1E BDL VERSION
110
$
$       SPONSOR:            National Science
Foundation
$
$       COPYRIGHT:          NSF, 2010.
$
$
$       DEVELOPER:          (PI) MARK J CLAYTON
$                           Professor
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-2300
$
$                           (Co-PI) JEFF HABERL
Ph.D, P.E.
$                           Professor
$                           Department of
Architecture
$                           Energy Systems
Laboratory
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-6065
$
$                           (Co-PI) WEI YAN
$                           Assistant Professor
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-0584
$
$       STUDENTS   :        JOSE LUIS BERMUDEZ
ALCOCER
$                           Ph.D. student
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$                           SANDEEP KOTA
$                           Ph.D. student
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$                           JONG BUM KIM
$                           Ph.D. student
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$                           WOONSEONG JEONG
$                           Ph.D. student
```

```
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$**********************************************
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```
INPUT LOADS  INPUT-UNITS = ENGLISH        $DOE-2
DEFAULT(OR METRIC)
             OUTPUT-UNITS = ENGLISH  ..   $DOE-2
DEFAULT(OR METRIC)

TITLE
LINE-1 *NSF PROJECT *
LINE-2 *TEST CASE-1 *
LINE-3 *ONE-ZONE MODEL* ..

RUN-PERIOD    JAN 14 2010 THRU JAN 14 2010
              AUG 9 2010 THRU AUG 9 2010
              JAN 1  2010 THRU DEC 31 2010
..

ABORT         ERRORS  ..
DIAGNOSTIC    DEFAULTS  ..        $ ADDED
COMMAND TO PRINT ALL THE DEFAULTS

LOADS-REPORT
SUMMARY  = (ALL-SUMMARY)          $ ADDED
COMMAND TO PRINT ALL THE LOADS SUMMARY REPORTS
VERIFICATION = (ALL-VERIFICATION) $ ADDED
COMMAND TO PRINT ALL THE LOADS VERIFICATION
REPORTS
REPORT-FREQUENCY      = HOURLY       $ DEFAULTS
FOR LOADS-REPORT
```

```
HOURLY-DATA-SAVE      = NO-SAVE   .. $ DEFAULTS
FOR LOADS-REPORT



$*****************************DESIGN
DAYS******************************

$ HOUSTON DESIGN DAYS FROM IECC1107 FILE.  DRY-
BULB AND DEW POINT TEMPERATURES FROM 1993 ASHRAE
HANDBOOK

WINTER1=DESIGN-DAY                 $ ALL VALUES
ARBITRARY
          DRYBULB-HI= 32           $ (DEG F)
          DRYBULB-LO= 32           $ (DEG F)
          HOUR-HI= 13              $ (HOURS)
          HOUR-LO= 1               $ (HOURS)
          DEWPT-HI= 19             $ (DEG F)
          DEWPT-LO= 19             $ (DEG F)
          DHOUR-HI= 15             $ (HOURS)
          DHOUR-LO=3               $ (HOURS)
          WIND-SPEED= 7            $ (KNOTS)
          WIND-DIR= 15              $
0=NORTH,1=NNE ...
          CLOUD-AMOUNT= 0          $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 1            $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6           $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 77  ..         $ (DEG F)
FROM REFERENCE PART II PAGE VIII.93

SUMMER1=DESIGN-DAY                 $ ALL VALUES
ARBITRARY
          DRYBULB-HI= 94           $(DEG F)
          DRYBULB-LO= 94           $(DEG F)
          HOUR-HI= 13              $(HOURS)
          HOUR-LO= 3               $(HOURS)
          DEWPT-HI= 77             $(DEG F)
          DEWPT-LO= 77             $(DEG F)
          DHOUR-HI= 15             $(HOURS)
          DHOUR-LO= 5              $(HOURS)
          WIND-SPEED= 5            $(KNOTS)
          WIND-DIR= 8              $
0=NORTH,1=NNE ...
          CLOUD-AMOUNT= 0          $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 0            $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6           $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 81  ..         $(DEG F) FROM
REFERENCE PART II PAGE VIII.93

$ ****************************************
BUILDING LOCATION INFORMATION
************************************************
**********


$ THE LOCATION INFORMATION LATITUDE/ LONGITUDE
AND ALTITUDE HAVE BEEN CHANGED FROM SAMP1E RUN3A
TO RUN THE SIMULATION FOR THE
$ HOUSTON WEATHER FILE.

BUILDING-LOCATION                 $ BUILDING
LOCATION INPUT COMMAND
LATITUDE              = 29.65   $ LATITUDE  FOR
CITY OF HOUSTON
LONGITUDE             = 95.28   $ LONGITUDE FOR
CITY OF HOUSTON
ALTITUDE              = 108.00  $ ALTITUDE FOR
CITY OF HOUSTON
```

```
HOLIDAY                = YES     $ DOE-2.1E
DEFAULT FOR HOLIDAYS = YES (USA-NATIONAL
HOLIDAYES)
TIME-ZONE              = 6       $ TIME ZONE FOR
THE CITY OF HOUSTON
AZIMUTH                = 0       $ BUILDING
AZIMUTH / SAMP1E RUN 3A  AZIMUTH = 30/ TESTCASE=
0
DAYLIGHT-SAVINGS       = YES     $ OPTIONS FOR
DAYLIGHT SAVINGS DOE-2.1E  DEFAULTS=YES
GROSS-AREA             = 5000    $ GROSS FLOOR
AREA OF THE CONDITIONED SPACE OF THE BUILDING
HEAT-PEAK-PERIOD       = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
COOL-PEAK-PERIOD       = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
ATM-MOISTURE           =
(0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7
)
                                 $ UNUSED DOE-
21.E DEFAULTS CALCULATED HOURLY FROM DEWPOINT
TEMP BY
ATM-TURBIDITY  =
(0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.
12,0.12,0.12)
                                 $ UNUSED DOE-
21.E DEFAULTS USED IF WEATHER FILE DO NOT HAVE
SOLAR DATA

X-REF                  = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
Y-REF                  = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
SHIELDING-COEF         = 0.2400  $ DOE-2
DEFAULT,THIS COEFFICIENT USED IN SHERMAN
GRIMSRUD INFILTRATION METHOD
TERRAIN-PAR1           = 0.8500  $ DOE-2 DEFAULT
IS A CONSTANT. USED TO MODIFY THE FREE STREAM
WIND SPEED TO ACCOUNT FOR GROUND ROUGHNESS AND
HEIGHT ABOVE GROUND LEVEL AT THE BUILDING SITE
TERRAIN-PAR2           = 0.2000  $ DOE-21.E
DEFAULTS IS A CONSTANT USED TO MODIFY THE FREE
STREAM WIND SPEED TO ACCOUNT FOR GROUND
ROUGHNESS AND HEIGHT ABOVE GROUND LEVEL AT THE
BUILDING SITE.

WS-TERRAIN-PAR1        = 1.0000  $ DOE-21.E
DEFAULTS IS A CONSTANT CORRESPONDING TO TERRAIN-
PART1, BUT FOR THE LOCATION OF THE WIND SPEED
MEASUREMENT; I.E., THE WEATHER STATION.
WS-TERRAIN-PAR2        = 0.1500  $ UNUSED DOE-
21.E DEFAULTS IS A CONSTANT CORRESPONDING TO
TERRAIN-PART2, BUT FOR THE LOCATION OF THE WIND
SPEED MEASUREMENT; I.E., THE WEATHER STATION.
WS-HEIGHT-LIST         = (33.0)  $ DOE-21.E
DEFAULTS
SOLAR-REFL-CALC        = NO-CALC $ DOE-21.E
DEFAULTS
SURF-TEMP-CALC         = NO   ..


$*************************************PARAMETERS
***********************************************
*
$**********SCHEDULES**********$

         B-SH-1 =SCHEDULE          THRU JAN 1
(ALL) (1,24)(1)
                                   THRU DEC 31
(ALL) (1,24)(1)  ..


$ BUILDING SHADES (REFERENCE FROM IECC1107.INP
FILE) $
```

```
BD1 = BUILDING-SHADE
           X = 0 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD2 = BUILDING-SHADE
           X = 0 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD3 = BUILDING-SHADE
           X = 20 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD4 = BUILDING-SHADE
           X = 20 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD5 = BUILDING-SHADE
           X = 40 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING


BD6 = BUILDING-SHADE
```

```
            X = 40 Y = 45 Z = 0
$COORDINATES
            HEIGHT = 10.0                    $(FT)
            WIDTH = 5.0                      $(FT)
            AZIMUTH = 90
$(DEGREES)
           TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
           TILT = 90
$(DEGREES),DEFAULT = 90
           SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD7 = BUILDING-SHADE
            X = 60 Y = 0 Z = 0
$COORDINATES
            HEIGHT = 10.0                    $(FT)
            WIDTH = 5.0                      $(FT)
            AZIMUTH = 90
$(DEGREES)
           TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
           TILT = 90
$(DEGREES),DEFAULT = 90
           SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD8 = BUILDING-SHADE
            X = 60 Y = 45 Z = 0
$COORDINATES
            HEIGHT = 10.0                    $(FT)
            WIDTH = 5.0                      $(FT)
            AZIMUTH = 90
$(DEGREES)
           TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
           TILT = 90
$(DEGREES),DEFAULT = 90
           SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD9 = BUILDING-SHADE
            X = 80 Y = 0 Z = 0
$COORDINATES
            HEIGHT = 10.0                    $(FT)
            WIDTH = 5.0                      $(FT)
            AZIMUTH = 90
$(DEGREES)
           TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
           TILT = 90
$(DEGREES),DEFAULT = 90
           SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD10 = BUILDING-SHADE
            X = 80 Y = 45 Z = 0
$COORDINATES
            HEIGHT = 10.0                    $(FT)
            WIDTH = 5.0                      $(FT)
            AZIMUTH = 90
$(DEGREES)
           TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
           TILT = 90
$(DEGREES),DEFAULT = 90
           SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD11 = BUILDING-SHADE
            X = 100 Y = 0 Z = 0
$COORDINATES
```

```
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD12 = BUILDING-SHADE
           X = 100 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD13 = BUILDING-SHADE
           X = 0 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                      $(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD14 = BUILDING-SHADE
           X = 8 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                      $(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD15 = BUILDING-SHADE
           X = 12 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD16 = BUILDING-SHADE
           X = 16 Y = 0 Z = 18.5
$COORDINATES
```

```
           HEIGHT = 24
$(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD17 = BUILDING-SHADE
           X = 20 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD18 = BUILDING-SHADE
           X = 24 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD19 = BUILDING-SHADE
           X = 28 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD20 = BUILDING-SHADE
           X = 32 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD21 = BUILDING-SHADE
```

```
           X = 36 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD22 = BUILDING-SHADE
           X = 40 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD23 = BUILDING-SHADE
           X = 44 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD24 = BUILDING-SHADE
           X = 48 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD25 = BUILDING-SHADE
           X = 52 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING
```

```
BD26 = BUILDING-SHADE
           X = 56 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD27 = BUILDING-SHADE
           X = 60 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD28 = BUILDING-SHADE
           X = 64 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD29 = BUILDING-SHADE
           X = 68 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD30 = BUILDING-SHADE
           X = 72 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
```

```
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD31 = BUILDING-SHADE
           X = 76 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD32 = BUILDING-SHADE
           X = 80 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD33 = BUILDING-SHADE
           X = 84 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD34 = BUILDING-SHADE
           X = 88 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD35 = BUILDING-SHADE
           X = 92 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
```

```
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD36 = BUILDING-SHADE
           X = 96 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

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*   BUILDING DESCRIPTION
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******   MATERIALS
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BUILTUP-ROOFING-MAT   = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS             = 0.0313     $(FT)
CONDUCTIVITY          = 0.0939
$(BTU.FT/HR.FT^2.F)
DENSITY               = 70        $(LB/FT^3)
SPECIFIC-HEAT         = 0.35  ..   $(BTU/LB.F)

ROOF-GRAVEL-MAT       = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.7 MATERIALS
LIBRARY)
THICKNESS             = 0.0417     $(FT)

CONDUCTIVITY          = 0.834
$(BTU.FT/HR.FT^2.F)
DENSITY               = 55         $(LB/FT^3)
SPECIFIC-HEAT         = 0.4  ..    $(BTU/LB.F)

POLY-EXP            = MATERIAL     $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS             = 0.4166     $(FT)
CONDUCTIVITY          = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY               = 1.8        $(LB/FT^3)
SPECIFIC-HEAT         = 0.29  ..   $(BTU/LB.F)
```

```
BRICK-4"              = MATERIAL   $
DOE2.1E(FROM REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS             = 0.3333     $(FT)
CONDUCTIVITY          = 0.4167
$(BTU.FT/HR.FT^2.F)
DENSITY               = 120        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2   ..   $(BTU/LB.F)

MIN-WOOL-FIB         = MATERIAL    $
DOE2.1E(FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS            = 0.2957      $ BATT, R-11
CONDUCTIVITY         = 0.0250
$(BTU.FT/HR.FT^2.F)
DENSITY              = 0.60        $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

GYPSUM               = MATERIAL    $
DOE2.1E(HOLLOW GYPSUM BOARD FROM REFERENCE 2ND
PART X.B.6 MATERIALS LIBRARY)
THICKNESS            = 0.0417      $(FT)
CONDUCTIVITY         = 0.0926
$(BTU.FT/HR.FT^2.F)
DENSITY              = 49.0        $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

AIR-LAYER-HALF-INCH  = MATERIAL   $ DOE2.1E(AIR
LAYER, ¾ IN. OR LESS FOR VERTICAL WALLS FROM
REFERENCE 2ND PART X.B.11 MATERIALS LIBRARY)
RESISTANCE           = 0.9  ..
$(HR.FT^2.F/BTU)

PLASTIC-FILM-SEAL    = MATERIAL   $
DOE2.1E(BUILDING PAPER TYPE FROM REFERENCE 2ND
PART X.B.2 MATERIALS LIBRARY) REPRESENTING TAR-
PAPER
RESISTANCE           = 0.01  ..
$(HR.FT^2.F/BTU)

PLYWOOD-HALF-INCH    = MATERIAL   $ DOE2.1E(FROM
REFERENCE 2ND PART X.B.7 MATERIALS LIBRARY)
THICKNESS            = 0.0417     $(FT)
CONDUCTIVITY         = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY              = 34.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.29  ..   $(BTU/LB.F)

SOFT-WOOD            = MATERIAL    $ DOE2.1E(3/4
IN. FROM REFERENCE 2ND PART X.B.8 MATERIALS
LIBRARY)
THICKNESS            = 0.0625      $(FT)
CONDUCTIVITY         = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY              = 34          $(LB/FT^3)
SPECIFIC-HEAT        = 0.33  ..    $(BTU/LB.F)

SOIL-12IN            = MATERIAL    $ SOIL LAYER
(FROM BUILDING ENERGY SIMULATION VOL. 23, No.6,
PAGES 21-22 WINKELMANN MEMO)
THICKNESS            = 1.0         $(FT)
CONDUCTIVITY         = 1.0
$(BTU.FT/HR.FT^2.F)
DENSITY              = 115         $(LB/FT^3)
SPECIFIC-HEAT        = 0.1  ..     $(BTU/LB.F)

CONCRETE-HE-WEIGHT   = MATERIAL    $ DOE2.1E(4
IN., DRIED AGGREGATE, 140 LB. FROM REFERENCE 2ND
PART X.B.3 MATERIALS LIBRARY)
THICKNESS            = 0.33        $(FT)
CONDUCTIVITY         = 0.7576
$(BTU.FT/HR.FT^2.F)
DENSITY              = 140.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)
```

```
CONCRETE-BLOCK-8"     = MATERIAL    $
DOE2.1E(CONCRETE FILLED FROM REFERENCE 2ND PART
X.B.6 MATERIALS LIBRARY)
THICKNESS             = 0.6667      $(FT)
CONDUCTIVITY          = 0.4359
$(BTU.FT/HR.FT^2.F)
DENSITY               = 115.0       $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

CONCRETE-LI-WEIGHT    = MATERIAL    $ DOE2.1E(4
IN., 80 LB. FROM REFERENCE 2ND PART X.B.5
MATERIALS LIBRARY)
THICKNESS             = 0.33        $(FT)
CONDUCTIVITY          = 0.2083
$(BTU.FT/HR.FT^2.F)
DENSITY               = 80.0        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

POLY-EXP-2             = MATERIAL   $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS              = 0.3333     $(FT)
CONDUCTIVITY           = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY                = 1.8        $(LB/FT^3)
SPECIFIC-HEAT          = 0.29  ..   $(BTU/LB.F)

MINERAL-WOOL1         = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
THICKNESS             = 0.2917       $(FT)
CONDUCTIVITY          = 0.027
$(BTU.FT/HR.FT^2.F)
DENSITY               = 0.6          $(LB/FT^3)
SPECIFIC-HEAT         = 0.2   ..     $(BTU/LB.F)

SOFT-WOOD1            = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
THICKNESS                = 0.2083      $(FT)
CONDUCTIVITY             = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY                  = 32          $(LB/FT^3)
SPECIFIC-HEAT            = 0.33  ..    $(BTU/LB.F)

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*****   LAYERS
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WA-1-2            = LAYERS           $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800            $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL          = (AIR-LAYER-HALF-INCH,BRICK-
4",PLASTIC-FILM-SEAL,
PLYWOOD-HALF-INCH,MIN-WOOL-FIB,GYPSUM,AIR-LAYER-
HALF-INCH)..  $ MATERIALS FROM OUTSIDE TO INSIDE

WA-1-3            = LAYERS           $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800            $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL          = (POLY-EXP-2,CONCRETE-LI-
WEIGHT)..  $ MATERIALS FROM OUTSIDE TO INSIDE

ROO-1            = LAYERS            $ LAYERS FOR
THE ROOF CONSTRUCTION
INSIDE-FILM-RES = 0.76               $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
```

```
MATERIAL         = (ROOF-GRAVEL-MAT,BUILTUP-
ROOFING-MAT,POLY-EXP,SOFT-WOOD)..
$ MATERIALS FROM OUTSIDE TO INSIDE

DOOR-LAY1         = LAYERS            $ REFERENCED
FROM IECC1107 FILE
MATERIAL          = (GYPSUM,MINERAL-WOOL1,
      SOFT-WOOD1,GYPSUM)   ..

$
************************************************
************************************************
***********************************
$
************************************************
*****   CONSTRUCTIONS
************************************************
**********
$
************************************************
************************************************
***********************************

WALL-1            = CONSTRUCTION     $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-2           $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000    ..     $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

WALL-2            = CONSTRUCTION     $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-3           $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000    ..     $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

ROOF-1            = CONSTRUCTION     $ ROOF
CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = ROO-1            $ LAYERS OF
THE ROOF CONSTRUCTION (LAYERED CONSTRUCTION)
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000  ..       $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

DOOR-1            = CONSTRUCTION   $ REFERENCED
FROM IECC1107 FILE)
LAYERS            = DOOR-LAY1
U                 = 0.2  ..        $ IECC
2001(RESIDENTIAL BUILDING)(BTU/HR.FT^2.F)

$
************************************************
************************************************
***********************************
$
************************************************
*****   WINDOWS/DOORS
************************************************
*************
$
************************************************
************************************************
***********************************

$ THE SIMULATION TOOL (DOE-2.1E) CAN ACCEPT
CUSTOM WINDOWS DESIGNED USING WINDOWS-5 (LBNL)
PROGRAM AS A
$ REASON WINDOWS AND DOORS ARE MODELED USING
WINDOWS-5 (LBNL) PROGRAM FOR CONSISTANCY .
```

```
W-1                =       GLASS-TYPE
$ CUSTOM WINDOW FOR LOWER SOUTH FRONT WALL AND
BACK WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001             $ GLASS
TYPE CODE
PANES              =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY
GLASS-CONDUCTANC =       1.4700           $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS          =       0.9000           $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS       =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS      =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS          =       0.7000           $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..        $ FROM
THE WINDOWS-5 LIBRARY

W-2                =       GLASS-TYPE
$ CUSTOM WINDOW FOR UPPER SOUTH FRONT WALL
WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001             $ GLASS
TYPE CODE
PANES              =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY
GLASS-CONDUCTANC =       1.4700           $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS          =       0.9000           $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS       =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS      =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS          =       0.7000           $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..        $ FROM
THE WINDOWS-5 LIBRARY

$
*************************************************
*************************************************
***********************************
$
*************************************************
*****   OCCUPANCY SCHEDULE
*************************************************
*****
$
*************************************************
*************************************************
***********************************

OC-1            = DAY-SCHEDULE  (1,8) (0.0)
                                (9,11) (1.0)
                                (12,14)
(0.8,0.4,0.8)
                                (15,18) (1.0)
                                (19,21)
(0.5,0.1,0.1)
                                (22,24) (0.0)
..
OC-2            = DAY-SCHEDULE  (1,24) (0.0)
..
OC-WEEK         = WEEK-SCHEDULE (WD) OC-1 (WEH)
OC-2    ..
OCCUPY-1        = SCHEDULE      THRU DEC 31 OC-
WEEK      ..

$
*************************************************
*************************************************
***********************************
```

```
$
*************************************************
*****   LIGHTING SCHEDULE
*************************************************
******
$
*************************************************
*************************************************
***********************************

LT-1            =DAY-SCHEDULE       (1,8) (0.05)
                                    (9,18) (1.0)
$OFFICE2 LIGHTING SCHEDULE HAS BEEN SET TO ONE
DURING OFFICE HOURS.
                                    (19,24)
(0.05)..

LT-2            =DAY-SCHEDULE       (1,24) (0.05)
..

LT-WEEK         =WEEK-SCHEDULE      (MON,FRI) LT-
1   (WEH) LT-2  ..

LIGHTS-1        =SCHEDULE           THRU DEC 31
LT-WEEK  ..

$
*************************************************
*************************************************
***********************************
$
*************************************************
*****   EQUIPMENT SCHEDULE
*************************************************
*****
$
*************************************************
*************************************************
***********************************
EQ-1            =DAY-SCHEDULE       (1,8) (0.02)
                                    (9,14)
(0.4,0.9,0.9,0.9,0.9,0.9)
                                    (15,20)
(0.8,0.7,0.5,0.5,0.3,0.3)
                                    (21,24) (0.02)
..
EQ-2            =DAY-SCHEDULE       (1,24) (0.2)
..
EQ-WEEK         =WEEK-SCHEDULE      (MON,FRI) EQ-1
(WEH) EQ-2  ..
EQUIP-1         =SCHEDULE            THRU DEC 31
EQ-WEEK  ..

$
*************************************************
*************************************************
***********************************
$
*************************************************
*****   INFILTRATION SCHEDULE
*************************************************
**
$
*************************************************
*************************************************
***********************************


$
*************************************************
*************************************************
***********************************
$
*************************************************
*****   GENERAL SPACE DEFINITIONS
************************************************
```

```
$
**************************************************
**************************************************
************************************

OFFICE                  = SPACE-CONDITIONS
..

$
**************************************************
**************************************************
************************************
$
**************************************************
*****   SPECIFIC SPACE DETAILS
**************************************************
**

$
**************************************************
**************************************************
************************************
$
**************************************************
**************************************************
************************************
$
**************************************************
*****         SPACE1-1
**************************************************
**
$
**************************************************
**************************************************
************************************

SPACE1-1                = SPACE
ZONE-TYPE               = CONDITIONED $ DOE2
DEFAULTS
AREA                    = 5000
VOLUME                  = 70000
X                       = 0.0000
Y                       = 0.0000       $ DOE2
DEFAULTS
Z                       = 10.0000      $ DOE2
DEFAULTS
AZIMUTH                 = 0.0000       $ DOE2
DEFAULTS
MULTIPLIER              = 1.0000       $ DOE2
DEFAULTS
FLOOR-WEIGHT            = 70           $ IECC
2001,402.1.3.3,DOE2 DEFAULTS IS 70
NUMBER-OF-PEOPLE        = 50
PEOPLE-SCHEDULE         = OCCUPY-1
PEOPLE-HEAT-GAIN        = 400          $ DOE2
DEFAULTS
PEOPLE-HG-LAT           = 130.3        $ DOE2
DEFAULTS
PEOPLE-HG-SENS          = 252.2        $ DOE2
DEFAULTS
EQUIP-SCHEDULE          = EQUIP-1
EQUIPMENT-W/SQFT        = 1            $ DOE2
DEFAULTS
AIR-CHANGES/HR          = 0.25         $ DOE2
DEFAULTS
TEMPERATURE             = (73)         $ DOE2
DEFAULTS
SOURCE-TYPE             = ELECTRIC     $ DOE2
DEFAULTS
SOURCE-POWER            = 0.0000       $ DOE2
DEFAULTS
EQUIP-LATENT            = 0.0000       $ DOE2
DEFAULTS
EQUIP-SENSIBLE          = 1.0000       $ DOE2
DEFAULTS
SOURCE-LATENT           = 0.5          $ DOE2
DEFAULTS
```

```
SOURCE-SENSIBLE      = 0.4         $ DOE2
DEFAULTS
FLOOR-MULTIPLIER     = 1.0000      $ DOE2
DEFAULTS
LIGHTING-SCHEDULE    = LIGHTS-1
LIGHTING-TYPE        = REC-FLUOR-RV
LIGHT-TO-SPACE       = 0.80
LIGHTING-W/SQFT      = 1.5
DAYLIGHTING         = YES         $ DAYLIGHING
OPTION IS SWITCHED ON
LIGHT-REF-POINT1    = (25,25,2.7) $ LOCATION OF
THE FIRST DAYLIGHT SENSOR
LIGHT-REF-POINT2    = (75,25,2.7) $ LOCTION OF
THE SECOND DAYLIGHT SENSOR
ZONE-FRACTION1      = 0.5         $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 1
ZONE-FRACTION2       = 0.5         $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 2
LIGHT-SET-POINT1     = 50          $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 1
LIGHT-SET-POINT2     = 50          $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 2
LIGHT-CTRL-TYPE1     = CONTINUOUS  $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 1
LIGHT-CTRL-TYPE2     = CONTINUOUS  $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 2
MIN-POWER-FRAC       = 0           $ LOWEST
INPUT POWER FRACTION FOR CONTINUOUSLY DIMMABLE
LIGHING CONTROL SYSTEM
MIN-LIGHT-FRAC       = 0   ..      $ SPECIFIES
THE FRACTIONAL LIGHT OUTPUT THAT A CONTINUOUSLY
DIMNMABLE
                                   $ LIGHTING
CONTROL SYSTEM PRODUCES AT THE MINIMUM
FRACTIONAL INPUT POWER GIVEN BY MIN-POWER-FRAC

FRONT-1              = EXTERIOR-WALL
HEIGHT               = 8
WIDTH                = 100
X                    = 0
Y                    = 0
Z                    = 0
AZIMUTH              = 180
CONSTRUCTION         = WALL-1
TILT                 = 90.0000   ..   $ DOE2
DEFAULTS

WF-1                 = WINDOW
WIDTH                = 45
HEIGHT               = 4.0000
X                    = 52.5
Y                    = 3.0000
GLASS-TYPE           = W-1   ..

FRONT-2              = EXTERIOR-WALL
HEIGHT               = 8
WIDTH                = 100
X                    = 0
Y                    = 25
Z                    = 16
AZIMUTH              = 180
CONSTRUCTION         = WALL-1
TILT                 = 90.0000   ..   $ DOE2
DEFAULTS

WF-2                 = WINDOW
WIDTH                = 90
HEIGHT               = 3.0000
X                    = 5
Y                    = 4.0000
GLASS-TYPE           = W-2   ..

PR1                  = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129
```

```
(100,0,0)(100,50,0)(100,50,8)(100,25,24)
(100,25,16)(100,0,8)  ..
RIGHT-1 = EXTERIOR-WALL   POLYGON = PR1
X                     = 100
Y                     = 0
Z                     = 0
CONSTRUCTION          = WALL-1   ..

DR-1                  = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                 = 3
HEIGHT                = 7
X                     = 25
Y                     = 0
SETBACK = 0.0                          $(FT)
CONSTRUCTION          = DOOR-1
$MULTIPLIER           =             UNUSED
$OVERHANG-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE       = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF             = 0.0         USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS    = 10
INSIDE-VIS-REFL       = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-2                  = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                 = 3
HEIGHT                = 7
X                     = 22
Y                     = 0
SETBACK = 0.0                          $(FT)
CONSTRUCTION          = DOOR-1
$MULTIPLIER           =             UNUSED
$OVERHANG-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE       = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
```

```
$LEFT-FIN-H            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF              = 0.0         USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR        = 0.5         $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR        = 0.5         $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS     = 10
INSIDE-VIS-REFL        = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

BACK-1                 = EXTERIOR-WALL
HEIGHT                 = 8
WIDTH                  = 100
X                      = 100
Y                      = 50
Z                      = 0
AZIMUTH                = 0
CONSTRUCTION           = WALL-1
TILT                   = 90.0000   ..    $DEGREES

WB-1                   = WINDOW
WIDTH                  = 24
HEIGHT                 = 4.0000
X                      = 11
Y                      = 3.0000
GLASS-TYPE             = W-1  ..

WB-2                   = WINDOW
WIDTH                  = 24
HEIGHT                 = 4.0000
X                      = 65
Y                      = 3.0000
GLASS-TYPE             = W-1  ..

PL1                    = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129


(0,50,0)(0,0,0)(0,0,8)(0,25,16)
(0,25,24)(0,50,8)    ..
LEFT-1                 = EXTERIOR-WALL  POLYGON =
PL1
X                      = 0
Y                      = 50
Z                      = 0
CONSTRUCTION           = WALL-1   ..

DR-3                   = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                  = 3
HEIGHT                 = 7
X                      = 25
Y                      = 0
SETBACK = 0.0                                 $(FT)
CONSTRUCTION           = DOOR-1
$MULTIPLIER            =             UNUSED
$OVERHANG-A            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE        = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
```

```
$LEFT-FIN-A             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF               = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR         = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR         = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS      = 10
INSIDE-VIS-REFL         = 0.0   ..         $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-4                    = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                   = 3
HEIGHT                  = 7
X                       = 22
Y                       = 0
SETBACK = 0.0                            $(FT)
CONSTRUCTION            = DOOR-1
$MULTIPLIER             =              UNUSED
$OVERHANG-A             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
```

```
$OVERHANG-W             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE         = 0.0          DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D             = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF               = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR         = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR         = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS      = 10
INSIDE-VIS-REFL         = 0.0   ..         $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

FLOOR-1                 = EXTERIOR-WALL
HEIGHT                  = 50
WIDTH                   = 100
X                       = 0
Y                       = 50
Z                       = 0
AZIMUTH                 = 180
```

```
CONSTRUCTION         = WALL-2
TILT                 = 180.0000   ..   $
REFERENCE FROM BUILDING ENERGY SIMULATION VOL.
23, No.6, PAGE 21 WINKELMANN MEMO

TOP-1                = EXTERIOR-WALL
HEIGHT               = 30.39
WIDTH                = 104
X                    = -2
Y                    = -3.95
Z                    = 6.73
AZIMUTH              = 180
CONSTRUCTION         = ROOF-1
TILT                 = 17.7400   ..    $ DOE2
DEFAULTS

TOP-2                = EXTERIOR-WALL
HEIGHT               = 36.35
WIDTH                = 104
X                    = 102
Y                    = 52.25
Z                    = 6.55
AZIMUTH              = 0
CONSTRUCTION         = ROOF-1
TILT                 = 32.6200   ..   $ DOE2
DEFAULTS

 $---HOURLY REPORTS---$

PLTSCH  = SCHEDULE   THRU JAN 14 (ALL) (1,24)
(1)
                     THRU AUG 9 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER1 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (1, 4, 6)   ..  $
CLEARNESS NUMBER, DRY BULB TEMPERATURE (°F),
CLOUD AMOUNT (0 TO 10) FROM REFERENCE PT1
III.101

PLOTER2 = REPORT-BLOCK
          VARIABLE-TYPE = BUILDING
          VARIABLE-LIST = (1, 2, 19, 20, 37)
.. $ BUILDING HEATING LOAD (SENSIBLE), BUILDING
HEATING LOAD (LATENT), BUILDING COOLING LOAD
(SENSIBLE), BUILDING COOLING LOAD (LATENT),
BUILDING ELECTRIC TOTAL FROM REFERENCE PT1
III.103 AND III.104

LDS-REP-1 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH
            REPORT-BLOCK    = (PLOTER1, PLOTER2)
            OPTION          = PRINT   ..

END  ..
COMPUTE  LOADS   ..

INPUT SYSTEMS   INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

               SYSTEMS-REPORT  SUMMARY = (ALL-
SUMMARY)
                               VERIFICATION
= (SV-A)
                               REPORT-FREQUENCY
= HOURLY
                               HOURLY-DATA-SAVE
= NO-SAVE   ..

               $ SYSTEMS SCHEDULES

FAN-1          =DAY-SCHEDULE       (1,24) (1)
..
```

```
FAN-2          =DAY-SCHEDULE       (1,24) (1)
..
FAN-SCHED      =SCHEDULE           THRU DEC 31
(WD) FAN-1 (WEH) FAN-2  ..

HEAT-1      =DAY-SCHEDULE    (1,24) (68)   ..
HEAT-2      =DAY-SCHEDULE    (1,24) (68)   ..
HEAT-WEEK   =WEEK-SCHEDULE   (MON,FRI)  HEAT-1
(WEH)  HEAT-2   ..
HEAT-SCHED  =SCHEDULE        THRU DEC 31   HEAT-
WEEK   ..
COOLOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24) (1)  ..
HEATOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24) (1)  ..

COOL-1      =DAY-SCHEDULE    (1,24) (78)   ..
COOL-2      =DAY-SCHEDULE    (1,24) (78)   ..
COOL-WEEK   =WEEK-SCHEDULE   (MON,FRI)  COOL-1
(WEH)  COOL-2   ..
COOL-SCHED  =SCHEDULE        THRU DEC 31   COOL-
WEEK   ..

R1          =DAY-RESET-SCH   SUPPLY-HI=60
SUPPLY-LO=52
                             OUTSIDE-LO=30
OUTSIDE-HI=75  ..
SAT-RESET   =RESET-SCHEDULE  THRU DEC 31 (ALL)
R1  ..

                    $ SYSTEM DESCRIPTION

ZAIR         =ZONE-AIR      OA-CFM/PER=0  ..

CONTROL      =ZONE-CONTROL  DESIGN-HEAT-T=70
DESIGN-COOL-T=76
                            HEAT-TEMP-SCH= HEAT-
SCHED
```

```
                            COOL-TEMP-SCH= COOL-
SCHED
                            THERMOSTAT-
TYPE=REVERSE-ACTION  ..

                      $ FOLLOWING AIR FLOWS ARE
FROM RUN 3 SV-A REPORT,
                      $ DIVIDED BY ALTITUDE
MULTIPLIER

SPACE1-1     =ZONE          ZONE-AIR=ZAIR
SIZING-OPTION=ADJUST-LOADS
                            ZONE-CONTROL      =
CONTROL
                            ZONE-TYPE         =
CONDITIONED
                            BASEBOARD-RATING  =
0.00        $ BTU/HR
                            PANEL-LOSS-RATIO  =
0.00        $ BTU/BTU
                            EXHAUST-EFF       =
0.75   $ FRAC. OR MULT.
                            BASEBOARD-CTRL    =
OUTDOOR-RESET
                            THROTTLING-RANGE  =
1.00        $ R
                            ZONE-FAN-KW/FLOW  =
0.0003      $ KW/CFM
                            TERMINAL-TYPE     =
SVAV
                            ZONE-REPORTS     =
YES   ..

S-CONT       =SYSTEM-CONTROL  COOLING-SCHEDULE=
COOLOFF
                              HEATING-SCHEDULE=
HEATOFF
                              HEAT-SET-T=65
                              COOL-CONTROL=RESET
```

```
                              COOL-RESET-                                         SIZING-RATIO
SCH=SAT-RESET                                        = 1.00 $ DOE-2.1 DEFAULT
                              MIN-SUPPLY-T=60 ..                                  HEAT-SIZING-RATIO
                                                     = 1.00 $ DOE-2.1 DEFAULT
S-FAN         =SYSTEM-FANS    FAN-SCHEDULE=FAN-                                   COOL-SIZING-RATI0
SCHED  FAN-CONTROL=SPEED                             = 1.00 $ DOE-2.1 DEFAULT
                              SUPPLY-STATIC=2.0                                   RETURN-AIR-PATH
SUPPLY-EFF=.55                                       = DIRECT
                              NIGHT-CYCLE-                                        HUMIDIFIER-TYPE
CTRL=CYCLE-ON-ANY  ..                                = ELECTRIC
                                                                                  SHW-HP-SOURCE
S-TERM        =SYSTEM-TERMINAL REHEAT-DELTA-T=58     = ZONE
                              MIN-CFM-RATIO=0.1                                   MAX-HUMIDITY
..                                                   = 100.00 $ PERCENT
                                                                                  MIN-HUMIDITY
SYST-1        =SYSTEM         SYSTEM-TYPE=VAVS       = 0.00   $ PERCENT
                              SUPPLY-CFM                                          PREHEAT-T
= 7366                                               = 45     $ F
                              SYSTEM-CONTROL                                      DESC-CTRL-MODE
= S-CONT                                             = 0.00
                              SYSTEM-FANS                                         DESC-DEW-SET
= S-FAN                                              = 50.00  $ F
                              SYSTEM-TERMINAL                                     OA-CONTROL
= S-TERM                                             = TEMP
                              ECONO-LIMIT-T                                       SUPPLY-DELTA-T  =
= 65                                                 3.37   $ R
                              ZONE-NAMES                                          SUPPLY-KW/FLOW  =
= (SPACE1-1)                                         0.0011 $ KW/CFM
                              HEAT-SOURCE                                         MOTOR-PLACEMENT =
= ELECTRIC                                           IN-AIRFLOW
                              ZONE-HEAT-SOURCE                                    FAN-PLACEMENT   =
= ELECTRIC                                           DRAW-THROUGH
                              PREHEAT-SOURCE                                      MAX-FAN-RATIO   =
= ELECTRIC                                           1.10   $ FRAC. OR MULT.
                              BASEBOARD-SOURCE                                    MIN-FAN-RATIO   =
= ELECTRIC                                           0.300  $ FRAC. OR MULT.
                              VARIABLE-T                                          NIGHT-VENT-CTRL =
= ON                                                 NOT-AVAILABLE
```

```
                              NIGHT-VENT-DT    =
5.0    $ R
                              RATED-CCAP-FFLOW
= SDL-C80
                              COOL-CAP-FT
= SDL-C7
                              COOL-SH-FT
= SDL-C27
                              COIL-BF
= 0.0370 $ FRAC. OR MULT.
                              COIL-BF-FFLOW
= SDL-C37
                              COIL-BF-FT
= SDL-C47   ..

PLANT1    = PLANT-ASSIGNMENT  SYSTEM-NAMES =
(SYST-1) $ REFERENCE FROM THE IECC1107 FILE
                              DHW-TYPE     =
ELECTRIC
                              DHW-SCH      =
DHWSCH-1
                              DHW-GAL/MIN  =
0.03472   .. $CALCULATED FROM ASHRAE 90.1 USER'S
MANUAL PAGE 7-14

DHWSCH-1  = SCHEDULE  THRU JAN 14 (ALL) (1,24)
(1)
                     THRU AUG 9 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLTSCH2  = SCHEDULE  THRU JAN 14 (ALL) (1,24)
(1)
                     THRU AUG 9 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER3 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
```

```
          VARIABLE-LIST = (8)    .. $ DRY BULB
TEMPERATURE (°F) FROM SUPLEMENT PAGE A.16

PLOTER4 = REPORT-BLOCK
          VARIABLE-TYPE = PLANT1
          VARIABLE-LIST = (1, 2, 3)    .. $ TOTAL
COOLING LOAD (Btu/hr), TOTAL HEATING LOAD
(Btu/hr), TOTAL ELECTRICAL LOAD (Kw) FROM
SUPLEMENT PAGE A.48

LDS-REP-2 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH2
            REPORT-BLOCK    = (PLOTER3, PLOTER4)
            OPTION          = PRINT   ..

END   ..
COMPUTE SYSTEMS   ..
INPUT PLANT     INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

PLANT1 = PLANT-ASSIGNMENT  ..

              PLANT-REPORT  SUMMARY=(PS-A, PS-E,
BEPS)  ..

                $ EQUIPMENT DESCRIPTION

                $ HOT-WATER BOILER

SBOIL1   =PLANT-EQUIPMENT  TYPE=HW-BOILER
SIZE=-999   .. $ AUTOSIZE

          PLANT-PARAMETERS  HERM-REC-COND-
TYPE=AIR  ..

                $ AIR-COOLED RECIPROCATING
CHILLER
```

```
CHIL1    =PLANT-EQUIPMENT  TYPE=HERM-REC-CHLR
SIZE=-999  .. $ AUTOSIZE

 PLANT-COSTS      PROJECT-LIFE=25  DISCOUNT-
RATE=5 ..
 ENERGY-RESOURCE  RESOURCE=ELECTRICITY  ..
 ENERGY-RESOURCE  RESOURCE=NATURAL-GAS
ENERGY/UNIT=100000
                  UNIT-NAME=THERMS   ..

END  ..
COMPUTE PLANT   ..
STOP ..
```

This is the input file for Houston that uses SYSTEM-TYPE=SUM

```
$TYPE OF BUILDING
$SAMPLE1E-RUN3A WITH MODIFICATION
$TEST CASE ONE SIX ZONE MODEL

$FILE NAME = 01A1.INP


$***********************************************
********************************
$       PROGRAM:            DOE-2 SIMULATION
INPUT FILE
$
$       LANGUAGE:           DOE-2.1E BDL VERSION
110
$
$       SPONSOR:            National Science
Foundation
$
$       COPYRIGHT:          NSF, 2010.
$
$
$       DEVELOPER:          (PI) MARK J CLAYTON
$                           Professor
$                           Department of
Architecture
$                           Texas A&M
University, College Station, T
$                           PHONE: (979)845-2300
$
$                           (Co-PI) JEFF HABERL
Ph.D, P.E.
$                           Professor
$                           Department of
Architecture
$                           Energy Systems
Laboratory
$                           Texas A&M
University, College Station, T
$                           PHONE: (979)845-6065
$
$                           (Co-PI) WEI YAN
$                           Assistant Professor
$                           Department of
Architecture
$                           Texas A&M
University, College Station, T
$                           PHONE: (979)845-0584
$
$       STUDENTS   :        JOSE LUIS BERMUDEZ
ALCOCER
$                           Ph.D. student
$                           Department of
Architecture
```

```
$                            Texas A&M
University, College Station, T
$
$                            SANDEEP KOTA
$                            Ph.D. student
$                            Department of
Architecture
$                            Texas A&M
University, College Station, T
$
$                            JONG BUM KIM
$                            Ph.D. student
$                            Department of
Architecture
$                            Texas A&M
University, College Station, T
$
$                            WOONSEONG JEONG
$                            Ph.D. student
$                            Department of
Architecture
$                            Texas A&M
University, College Station, T
$
$************************************************
********************************


$                  -----------------------------
-------------------------
$                 !
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!
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$                 !
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$                 !
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$                 !
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$                 !
!
$                 !
!
$                 !                     SPACE1-1
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$                 !
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$                 !
!
$                 !
!
$                 !
!
$                 !
!
$                 !
!
$                 !
!
$                  ------------------------------
-------------------------

INPUT LOADS  INPUT-UNITS = ENGLISH        $DOE-2
DEFAULT(OR METRIC)
             OUTPUT-UNITS = ENGLISH  ..   $DOE-2
DEFAULT(OR METRIC)

TITLE
LINE-1 *NSF PROJECT *
LINE-2 *TEST CASE-1 *
```

```
LINE-3 *ONE-ZONE MODEL* ..

RUN-PERIOD    JAN 14 2010 THRU JAN 14 2010
              AUG 9 2010 THRU AUG 9 2010
              JAN 1  2010 THRU DEC 31 2010
..

ABORT         ERRORS  ..
DIAGNOSTIC    DEFAULTS  ..        $ ADDED
COMMAND TO PRINT ALL THE DEFAULTS

LOADS-REPORT
SUMMARY  = (ALL-SUMMARY)          $ ADDED
COMMAND TO PRINT ALL THE LOADS SUMMARY REPORTS
VERIFICATION = (ALL-VERIFICATION) $ ADDED
COMMAND TO PRINT ALL THE LOADS VERIFICATION
REPORTS
REPORT-FREQUENCY      = HOURLY       $ DEFAULTS
FOR LOADS-REPORT
HOURLY-DATA-SAVE      = NO-SAVE   .. $ DEFAULTS
FOR LOADS-REPORT




$******************************DESIGN
DAYS*****************************

$ HOUSTON DESIGN DAYS FROM IECC1107 FILE.  DRY-
BULB AND DEW POINT TEMPERATURES FROM 1993 ASHRAE
HANDBOOK

WINTER1=DESIGN-DAY                 $ ALL VALUES
ARBITRARY
          DRYBULB-HI= 32           $ (DEG F)
          DRYBULB-LO= 32           $ (DEG F)
          HOUR-HI= 13              $ (HOURS)
          HOUR-LO= 1               $ (HOURS)
          DEWPT-HI= 19             $ (DEG F)
          DEWPT-LO= 19              $ (DEG F)
          DHOUR-HI= 15              $ (HOURS)
          DHOUR-LO=3                $ (HOURS)
          WIND-SPEED= 7             $ (KNOTS)
          WIND-DIR= 15               $
0=NORTH,1=NNE ...
          CLOUD-AMOUNT= 0           $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 1             $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6            $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 77  ..          $ (DEG F)
FROM REFERENCE PART II PAGE VIII.93

SUMMER1=DESIGN-DAY                  $ ALL VALUES
ARBITRARY
          DRYBULB-HI= 94            $(DEG F)
          DRYBULB-LO= 94            $(DEG F)
          HOUR-HI= 13               $(HOURS)
          HOUR-LO= 3                $(HOURS)
          DEWPT-HI= 77              $(DEG F)
          DEWPT-LO= 77              $(DEG F)
          DHOUR-HI= 15              $(HOURS)
          DHOUR-LO= 5               $(HOURS)
          WIND-SPEED= 5             $(KNOTS)
          WIND-DIR= 8               $
0=NORTH,1=NNE ...
          CLOUD-AMOUNT= 0           $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 0             $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6            $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 81  ..          $(DEG F) FROM
REFERENCE PART II PAGE VIII.93

$ ****************************************
BUILDING LOCATION INFORMATION
```

```
*************************************************
**********


$ THE LOCATION INFORMATION LATITUDE/ LONGITUDE
AND ALTITUDE HAVE BEEN CHANGED FROM SAMP1E RUN3A
TO RUN THE SIMULATION FOR THE
$ HOUSTON WEATHER FILE.

BUILDING-LOCATION                $ BUILDING
LOCATION INPUT COMMAND
LATITUDE             = 29.65   $ LATITUDE  FOR
CITY OF HOUSTON
LONGITUDE            = 95.28   $ LONGITUDE FOR
CITY OF HOUSTON
ALTITUDE             = 108.00  $ ALTITUDE FOR
CITY OF HOUSTON
HOLIDAY              = YES     $ DOE-2.1E
DEFAULT FOR HOLIDAYS = YES (USA-NATIONAL
HOLIDAYES)
TIME-ZONE            = 6       $ TIME ZONE FOR
THE CITY OF HOUSTON
AZIMUTH              = 0       $ BUILDING
AZIMUTH / SAMP1E RUN 3A  AZIMUTH = 30/ TESTCASE=
0
DAYLIGHT-SAVINGS     = YES     $ OPTIONS FOR
DAYLIGHT SAVINGS DOE-2.1E  DEFAULTS=YES
GROSS-AREA           = 5000    $ GROSS FLOOR
AREA OF THE CONDITIONED SPACE OF THE BUILDING
HEAT-PEAK-PERIOD     = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
COOL-PEAK-PERIOD     = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
ATM-MOISTURE         =
(0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7
)
                               $ UNUSED DOE-
21.E DEFAULTS CALCULATED HOURLY FROM DEWPOINT
TEMP BY
ATM-TURBIDITY  =
(0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.
12,0.12,0.12)
                                $ UNUSED DOE-
21.E DEFAULTS USED IF WEATHER FILE DO NOT HAVE
SOLAR DATA

X-REF                 = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
Y-REF                 = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
SHIELDING-COEF        = 0.2400  $ DOE-2
DEFAULT,THIS COEFFICIENT USED IN SHERMAN
GRIMSRUD INFILTRATION METHOD

TERRAIN-PAR1          = 0.8500  $ DOE-2 DEFAULT
IS A CONSTANT. USED TO MODIFY THE FREE STREAM
WIND SPEED TO ACCOUNT FOR GROUND ROUGHNESS AND
HEIGHT ABOVE GROUND LEVEL AT THE BUILDING SITE
TERRAIN-PAR2          = 0.2000  $ DOE-21.E
DEFAULTS IS A CONSTANT USED TO MODIFY THE FREE
STREAM WIND SPEED TO ACCOUNT FOR GROUND
ROUGHNESS AND HEIGHT ABOVE GROUND LEVEL AT THE
BUILDING SITE.

WS-TERRAIN-PAR1       = 1.0000  $ DOE-21.E
DEFAULTS IS A CONSTANT CORRESPONDING TO TERRAIN-
PART1, BUT FOR THE LOCATION OF THE WIND SPEED
MEASUREMENT; I.E., THE WEATHER STATION.
WS-TERRAIN-PAR2       = 0.1500  $ UNUSED DOE-
21.E DEFAULTS IS A CONSTANT CORRESPONDING TO
TERRAIN-PART2, BUT FOR THE LOCATION OF THE WIND
SPEED MEASUREMENT; I.E., THE WEATHER STATION.
WS-HEIGHT-LIST        = (33.0)  $ DOE-21.E
DEFAULTS
SOLAR-REFL-CALC       = NO-CALC $ DOE-21.E
DEFAULTS
```

```
SURF-TEMP-CALC        = NO   ..


$**********************************PARAMETERS
*******************************************
*
$**********SCHEDULES**********$

          B-SH-1 =SCHEDULE           THRU JAN 1
(ALL) (1,24)(1)
                                     THRU DEC 31
(ALL) (1,24)(1)  ..

$ BUILDING SHADES (REFERENCE FROM IECC1107.INP
FILE) $

BD1 = BUILDING-SHADE
           X = 0 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD2 = BUILDING-SHADE
           X = 0 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD3 = BUILDING-SHADE
           X = 20 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD4 = BUILDING-SHADE
           X = 20 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD5 = BUILDING-SHADE
```

```
          X = 40 Y = 0 Z = 0
$COORDINATES
          HEIGHT = 10.0                    $(FT)
          WIDTH = 5.0                      $(FT)
          AZIMUTH = 90
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 90
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD6 = BUILDING-SHADE
          X = 40 Y = 45 Z = 0
$COORDINATES
          HEIGHT = 10.0                    $(FT)
          WIDTH = 5.0                      $(FT)
          AZIMUTH = 90
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 90
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD7 = BUILDING-SHADE
          X = 60 Y = 0 Z = 0
$COORDINATES
          HEIGHT = 10.0                    $(FT)
          WIDTH = 5.0                      $(FT)
          AZIMUTH = 90
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 90
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD8 = BUILDING-SHADE
          X = 60 Y = 45 Z = 0
$COORDINATES
          HEIGHT = 10.0                    $(FT)
          WIDTH = 5.0                      $(FT)
          AZIMUTH = 90
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 90
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD9 = BUILDING-SHADE
          X = 80 Y = 0 Z = 0
$COORDINATES
          HEIGHT = 10.0                    $(FT)
          WIDTH = 5.0                      $(FT)
          AZIMUTH = 90
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 90
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD10 = BUILDING-SHADE
          X = 80 Y = 45 Z = 0
$COORDINATES
```

```
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD11 = BUILDING-SHADE
           X = 100 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD12 = BUILDING-SHADE
           X = 100 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD13 = BUILDING-SHADE
           X = 0 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                      $(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD14 = BUILDING-SHADE
           X = 8 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                      $(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD15 = BUILDING-SHADE
           X = 12 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
```

```
          WIDTH  = 4                    $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD16 = BUILDING-SHADE
          X = 16 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                    $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD17 = BUILDING-SHADE
          X = 20 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                    $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD18 = BUILDING-SHADE
          X = 24 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                    $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD19 = BUILDING-SHADE
          X = 28 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                    $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD20 = BUILDING-SHADE
          X = 32 Y = 0 Z = 18.5
$COORDINATES
```

```
          HEIGHT = 24
$(FT)
          WIDTH  = 4                     $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD21 = BUILDING-SHADE
          X = 36 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                     $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD22 = BUILDING-SHADE
          X = 40 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                     $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD23 = BUILDING-SHADE
          X = 44 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                     $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD24 = BUILDING-SHADE
          X = 48 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                     $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD25 = BUILDING-SHADE
```

```
           X = 52 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                         $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0                 $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..         $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD26 = BUILDING-SHADE
           X = 56 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                         $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0                 $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..         $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD27 = BUILDING-SHADE
           X = 60 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                         $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0                 $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..         $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD28 = BUILDING-SHADE
           X = 64 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                         $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0                 $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..         $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD29 = BUILDING-SHADE
           X = 68 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                         $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0                 $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..         $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING
```

```
BD30 = BUILDING-SHADE
           X = 72 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD31 = BUILDING-SHADE
           X = 76 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD32 = BUILDING-SHADE
           X = 80 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD33 = BUILDING-SHADE
           X = 84 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD34 = BUILDING-SHADE
           X = 88 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                     $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
```

```
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD35 = BUILDING-SHADE
           X = 92 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD36 = BUILDING-SHADE
           X = 96 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

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*   BUILDING DESCRIPTION
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******   MATERIALS
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BUILTUP-ROOFING-MAT   = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS             = 0.0313     $(FT)
CONDUCTIVITY          = 0.0939
$(BTU.FT/HR.FT^2.F)
DENSITY               = 70        $(LB/FT^3)
SPECIFIC-HEAT         = 0.35  ..   $(BTU/LB.F)

ROOF-GRAVEL-MAT       = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.7 MATERIALS
LIBRARY)
```

```
THICKNESS             = 0.0417     $(FT)

CONDUCTIVITY          = 0.834
$(BTU.FT/HR.FT^2.F)
DENSITY               = 55         $(LB/FT^3)
SPECIFIC-HEAT         = 0.4  ..    $(BTU/LB.F)

POLY-EXP            = MATERIAL     $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS             = 0.4166     $(FT)
CONDUCTIVITY          = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY               = 1.8        $(LB/FT^3)
SPECIFIC-HEAT         = 0.29  ..   $(BTU/LB.F)

BRICK-4"              = MATERIAL   $
DOE2.1E(FROM REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS             = 0.3333     $(FT)
CONDUCTIVITY          = 0.4167
$(BTU.FT/HR.FT^2.F)
DENSITY               = 120        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2   ..   $(BTU/LB.F)

MIN-WOOL-FIB         = MATERIAL    $
DOE2.1E(FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS            = 0.2957      $ BATT, R-11
CONDUCTIVITY         = 0.0250
$(BTU.FT/HR.FT^2.F)
DENSITY              = 0.60        $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

GYPSUM               = MATERIAL    $
DOE2.1E(HOLLOW GYPSUM BOARD FROM REFERENCE 2ND
PART X.B.6 MATERIALS LIBRARY)
THICKNESS            = 0.0417      $(FT)
CONDUCTIVITY          = 0.0926
$(BTU.FT/HR.FT^2.F)
DENSITY               = 49.0         $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..      $(BTU/LB.F)

AIR-LAYER-HALF-INCH  = MATERIAL   $ DOE2.1E(AIR
LAYER, ¾ IN. OR LESS FOR VERTICAL WALLS FROM
REFERENCE 2ND PART X.B.11 MATERIALS LIBRARY)
RESISTANCE            = 0.9  ..
$(HR.FT^2.F/BTU)

PLASTIC-FILM-SEAL     = MATERIAL   $
DOE2.1E(BUILDING PAPER TYPE FROM REFERENCE 2ND
PART X.B.2 MATERIALS LIBRARY) REPRESENTING TAR-
PAPER
RESISTANCE            = 0.01  ..
$(HR.FT^2.F/BTU)

PLYWOOD-HALF-INCH     = MATERIAL   $ DOE2.1E(FROM
REFERENCE 2ND PART X.B.7 MATERIALS LIBRARY)
THICKNESS             = 0.0417     $(FT)
CONDUCTIVITY          = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY               = 34.0       $(LB/FT^3)
SPECIFIC-HEAT         = 0.29  ..   $(BTU/LB.F)

SOFT-WOOD             = MATERIAL    $ DOE2.1E(3/4
IN. FROM REFERENCE 2ND PART X.B.8 MATERIALS
LIBRARY)
THICKNESS             = 0.0625       $(FT)
CONDUCTIVITY          = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY               = 34           $(LB/FT^3)
SPECIFIC-HEAT         = 0.33  ..     $(BTU/LB.F)

SOIL-12IN             = MATERIAL     $ SOIL LAYER
(FROM BUILDING ENERGY SIMULATION VOL. 23, No.6,
PAGES 21-22 WINKELMANN MEMO)
THICKNESS             = 1.0          $(FT)
```

```
CONDUCTIVITY          = 1.0
$(BTU.FT/HR.FT^2.F)
DENSITY               = 115         $(LB/FT^3)
SPECIFIC-HEAT         = 0.1  ..     $(BTU/LB.F)

CONCRETE-HE-WEIGHT   = MATERIAL    $ DOE2.1E(4
IN., DRIED AGGREGATE, 140 LB. FROM REFERENCE 2ND
PART X.B.3 MATERIALS LIBRARY)
THICKNESS             = 0.33        $(FT)
CONDUCTIVITY          = 0.7576
$(BTU.FT/HR.FT^2.F)
DENSITY               = 140.0       $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

CONCRETE-BLOCK-8"    = MATERIAL    $
DOE2.1E(CONCRETE FILLED FROM REFERENCE 2ND PART
X.B.6 MATERIALS LIBRARY)
THICKNESS             = 0.6667      $(FT)
CONDUCTIVITY          = 0.4359
$(BTU.FT/HR.FT^2.F)
DENSITY               = 115.0       $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

CONCRETE-LI-WEIGHT   = MATERIAL    $ DOE2.1E(4
IN., 80 LB. FROM REFERENCE 2ND PART X.B.5
MATERIALS LIBRARY)
THICKNESS             = 0.33        $(FT)
CONDUCTIVITY          = 0.2083
$(BTU.FT/HR.FT^2.F)
DENSITY               = 80.0        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

POLY-EXP-2             = MATERIAL   $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS              = 0.3333     $(FT)
CONDUCTIVITY           = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY                = 1.8        $(LB/FT^3)
SPECIFIC-HEAT          = 0.29  ..   $(BTU/LB.F)

MINERAL-WOOL1          = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
THICKNESS              = 0.2917       $(FT)
CONDUCTIVITY           = 0.027
$(BTU.FT/HR.FT^2.F)
DENSITY                = 0.6          $(LB/FT^3)
SPECIFIC-HEAT          = 0.2   ..     $(BTU/LB.F)

SOFT-WOOD1             = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
THICKNESS              = 0.2083      $(FT)
CONDUCTIVITY           = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY                = 32          $(LB/FT^3)
SPECIFIC-HEAT          = 0.33  ..    $(BTU/LB.F)

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*****   LAYERS
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$***********************************************
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WA-1-2             = LAYERS          $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800            $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL           = (AIR-LAYER-HALF-INCH,BRICK-
4",PLASTIC-FILM-SEAL,
```

```
PLYWOOD-HALF-INCH,MIN-WOOL-FIB,GYPSUM,AIR-LAYER-
HALF-INCH)..  $ MATERIALS FROM OUTSIDE TO INSIDE

WA-1-3            = LAYERS           $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800            $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL          = (POLY-EXP-2,CONCRETE-LI-
WEIGHT)..  $ MATERIALS FROM OUTSIDE TO INSIDE

ROO-1            = LAYERS            $ LAYERS FOR
THE ROOF CONSTRUCTION
INSIDE-FILM-RES = 0.76               $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL         = (ROOF-GRAVEL-MAT,BUILTUP-
ROOFING-MAT,POLY-EXP,SOFT-WOOD)..
$ MATERIALS FROM OUTSIDE TO INSIDE

DOOR-LAY1         = LAYERS            $ REFERENCED
FROM IECC1107 FILE
MATERIAL          = (GYPSUM,MINERAL-WOOL1,
      SOFT-WOOD1,GYPSUM)   ..

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*****   CONSTRUCTIONS
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WALL-1            = CONSTRUCTION     $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-2           $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000    ..     $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

WALL-2            = CONSTRUCTION     $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-3           $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000    ..     $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

ROOF-1            = CONSTRUCTION     $ ROOF
CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = ROO-1            $ LAYERS OF
THE ROOF CONSTRUCTION (LAYERED CONSTRUCTION)
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000  ..       $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

DOOR-1            = CONSTRUCTION   $ REFERENCED
FROM IECC1107 FILE)
LAYERS            = DOOR-LAY1
U                 = 0.2  ..        $ IECC
2001(RESIDENTIAL BUILDING)(BTU/HR.FT^2.F)

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*****   WINDOWS/DOORS
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$ THE SIMULATION TOOL (DOE-2.1E) CAN ACCEPT
CUSTOM WINDOWS DESIGNED USING WINDOWS-5 (LBNL)
PROGRAM AS A
$ REASON WINDOWS AND DOORS ARE MODELED USING
WINDOWS-5 (LBNL) PROGRAM FOR CONSISTANCY .

W-1              =       GLASS-TYPE
$ CUSTOM WINDOW FOR LOWER SOUTH FRONT WALL AND
BACK WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001             $ GLASS
TYPE CODE
PANES            =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY
GLASS-CONDUCTANC =       1.4700           $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS        =       0.9000           $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS     =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS    =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS        =       0.7000           $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..        $ FROM
THE WINDOWS-5 LIBRARY

W-2              =       GLASS-TYPE
$ CUSTOM WINDOW FOR UPPER SOUTH FRONT WALL
WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001             $ GLASS
TYPE CODE
PANES            =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY
GLASS-CONDUCTANC =       1.4700           $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS        =       0.9000           $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS     =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS    =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS        =       0.7000           $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..        $ FROM
THE WINDOWS-5 LIBRARY

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*****   OCCUPANCY SCHEDULE
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OC-1            = DAY-SCHEDULE  (1,8) (0.0)
                                (9,11) (1.0)
                                (12,14)
(0.8,0.4,0.8)
                                (15,18) (1.0)
```

```
                                (19,21)
(0.5,0.1,0.1)
                                (22,24) (0.0)
..
OC-2            = DAY-SCHEDULE  (1,24) (0.0)
..
OC-WEEK         = WEEK-SCHEDULE (WD) OC-1 (WEH)
OC-2    ..
OCCUPY-1        = SCHEDULE      THRU DEC 31 OC-
WEEK     ..

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*****   LIGHTING SCHEDULE
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LT-1            =DAY-SCHEDULE      (1,8) (0.05)
                                   (9,18) (1.0)
$OFFICE2 LIGHTING SCHEDULE HAS BEEN SET TO ONE
DURING OFFICE HOURS.
                                   (19,24)
(0.05)..

LT-2            =DAY-SCHEDULE      (1,24) (0.05)
..

LT-WEEK         =WEEK-SCHEDULE     (MON,FRI) LT-
1    (WEH) LT-2  ..
LIGHTS-1        =SCHEDULE          THRU DEC 31
LT-WEEK  ..

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*****   EQUIPMENT SCHEDULE
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EQ-1            =DAY-SCHEDULE      (1,8) (0.02)
                                   (9,14)
(0.4,0.9,0.9,0.9,0.9,0.9)
                                   (15,20)
(0.8,0.7,0.5,0.5,0.3,0.3)
                                   (21,24) (0.02)
..
EQ-2            =DAY-SCHEDULE      (1,24) (0.2)
..
EQ-WEEK         =WEEK-SCHEDULE     (MON,FRI) EQ-1
(WEH) EQ-2  ..
EQUIP-1         =SCHEDULE          THRU DEC 31
EQ-WEEK  ..

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*****   INFILTRATION SCHEDULE
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*****   GENERAL SPACE DEFINITIONS
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OFFICE                = SPACE-CONDITIONS
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*****   SPECIFIC SPACE DETAILS
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*****          SPACE1-1
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SPACE1-1                = SPACE
ZONE-TYPE               = CONDITIONED $ DOE2
DEFAULTS
AREA                    = 5000
VOLUME                  = 70000
X                       = 0.0000
Y                       = 0.0000      $ DOE2
DEFAULTS
Z                       = 10.0000     $ DOE2
DEFAULTS
AZIMUTH                 = 0.0000      $ DOE2
DEFAULTS
MULTIPLIER              = 1.0000      $ DOE2
DEFAULTS
FLOOR-WEIGHT            = 70          $ IECC
2001,402.1.3.3,DOE2 DEFAULTS IS 70
NUMBER-OF-PEOPLE        = 50
PEOPLE-SCHEDULE         = OCCUPY-1
PEOPLE-HEAT-GAIN        = 400         $ DOE2
DEFAULTS
PEOPLE-HG-LAT           = 130.3       $ DOE2
DEFAULTS
PEOPLE-HG-SENS          = 252.2       $ DOE2
DEFAULTS
EQUIP-SCHEDULE          = EQUIP-1
```

```
EQUIPMENT-W/SQFT     = 1            $ DOE2
DEFAULTS
AIR-CHANGES/HR       = 0.25         $ DOE2
DEFAULTS
TEMPERATURE          = (73)         $ DOE2
DEFAULTS
SOURCE-TYPE          = ELECTRIC     $ DOE2
DEFAULTS
SOURCE-POWER         = 0.0000       $ DOE2
DEFAULTS
EQUIP-LATENT         = 0.0000       $ DOE2
DEFAULTS
EQUIP-SENSIBLE       = 1.0000       $ DOE2
DEFAULTS
SOURCE-LATENT        = 0.5          $ DOE2
DEFAULTS
SOURCE-SENSIBLE      = 0.4          $ DOE2
DEFAULTS
FLOOR-MULTIPLIER     = 1.0000       $ DOE2
DEFAULTS
LIGHTING-SCHEDULE    = LIGHTS-1
LIGHTING-TYPE        = REC-FLUOR-RV
LIGHT-TO-SPACE       = 0.80
LIGHTING-W/SQFT      = 1.5
DAYLIGHTING         = YES          $ DAYLIGHING
OPTION IS SWITCHED ON
LIGHT-REF-POINT1    = (25,25,2.7) $ LOCATION OF
THE FIRST DAYLIGHT SENSOR
LIGHT-REF-POINT2    = (75,25,2.7) $ LOCTION OF
THE SECOND DAYLIGHT SENSOR
ZONE-FRACTION1      = 0.5          $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 1
ZONE-FRACTION2       = 0.5          $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 2
LIGHT-SET-POINT1     = 50           $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 1
LIGHT-SET-POINT2     = 50           $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 2
```

```
LIGHT-CTRL-TYPE1     = CONTINUOUS  $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 1
LIGHT-CTRL-TYPE2     = CONTINUOUS  $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 2
MIN-POWER-FRAC       = 0           $ LOWEST
INPUT POWER FRACTION FOR CONTINUOUSLY DIMMABLE
LIGHING CONTROL SYSTEM
MIN-LIGHT-FRAC       = 0   ..      $ SPECIFIES
THE FRACTIONAL LIGHT OUTPUT THAT A CONTINUOUSLY
DIMNMABLE
                                   $ LIGHTING
CONTROL SYSTEM PRODUCES AT THE MINIMUM
FRACTIONAL INPUT POWER GIVEN BY MIN-POWER-FRAC

FRONT-1              = EXTERIOR-WALL
HEIGHT               = 8
WIDTH                = 100
X                    = 0
Y                    = 0
Z                    = 0
AZIMUTH              = 180
CONSTRUCTION         = WALL-1
TILT                 = 90.0000   ..   $ DOE2
DEFAULTS

WF-1                 = WINDOW
WIDTH                = 45
HEIGHT               = 4.0000
X                    = 52.5
Y                    = 3.0000
GLASS-TYPE           = W-1   ..

FRONT-2              = EXTERIOR-WALL
HEIGHT               = 8
WIDTH                = 100
X                    = 0
Y                    = 25
```

```
Z                    = 16
AZIMUTH              = 180
CONSTRUCTION         = WALL-1
TILT                 = 90.0000   ..   $ DOE2
DEFAULTS

WF-2                 = WINDOW
WIDTH                = 90
HEIGHT               = 3.0000
X                    = 5
Y                    = 4.0000
GLASS-TYPE           = W-2   ..

PR1                  = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129


(100,0,0)(100,50,0)(100,50,8)(100,25,24)
(100,25,16)(100,0,8)  ..
RIGHT-1 = EXTERIOR-WALL   POLYGON = PR1
X                    = 100
Y                    = 0
Z                    = 0
CONSTRUCTION         = WALL-1   ..

DR-1                 = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                = 3
HEIGHT               = 7
X                    = 25
Y                    = 0
SETBACK = 0.0                            $(FT)
CONSTRUCTION         = DOOR-1
$MULTIPLIER          =           UNUSED
$OVERHANG-A          = 0.0       DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B          = 0.0       DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE      = 0.0          DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A         = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B         = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H         = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D         = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF            = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR      = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR      = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS   = 10
INSIDE-VIS-REFL      = 0.0   ..         $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-2                 = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                = 3
HEIGHT               = 7
X                    = 22
Y                    = 0
SETBACK = 0.0                            $(FT)
```

```
CONSTRUCTION          = DOOR-1
$MULTIPLIER           =              UNUSED
$OVERHANG-A           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE       = 0.0          DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF             = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR       = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR       = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS    = 10
INSIDE-VIS-REFL       = 0.0   ..         $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

BACK-1                = EXTERIOR-WALL
```

```
HEIGHT                = 8
WIDTH                 = 100
X                     = 100
Y                     = 50
Z                     = 0
AZIMUTH               = 0
CONSTRUCTION          = WALL-1
TILT                  = 90.0000   ..    $DEGREES

WB-1                  = WINDOW
WIDTH                 = 24
HEIGHT                = 4.0000
X                     = 11
Y                     = 3.0000
GLASS-TYPE            = W-1  ..

WB-2                  = WINDOW
WIDTH                 = 24
HEIGHT                = 4.0000
X                     = 65
Y                     = 3.0000
GLASS-TYPE            = W-1  ..

PL1                   = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129

(0,50,0)(0,0,0)(0,0,8)(0,25,16)
(0,25,24)(0,50,8)   ..
LEFT-1                = EXTERIOR-WALL  POLYGON =
PL1
X                     = 0
Y                     = 50
Z                     = 0
CONSTRUCTION          = WALL-1   ..

DR-3                  = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                 = 3
```

```
HEIGHT                  = 7
X                       = 25
Y                       = 0
SETBACK = 0.0                         $(FT)
CONSTRUCTION            = DOOR-1
$MULTIPLIER             =             UNUSED
$OVERHANG-A             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE         = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF               = 0.0         USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR         = 0.5         $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR         = 0.5         $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS      = 10
```

```
INSIDE-VIS-REFL         = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-4                    = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                   = 3
HEIGHT                  = 7
X                       = 22
Y                       = 0
SETBACK = 0.0                         $(FT)
CONSTRUCTION            = DOOR-1
$MULTIPLIER             =             UNUSED
$OVERHANG-A             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE         = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
```

```
$INF-COEF              = 0.0         USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR        = 0.5         $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR        = 0.5         $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS     = 10
INSIDE-VIS-REFL        = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

FLOOR-1                = EXTERIOR-WALL
HEIGHT                 = 50
WIDTH                  = 100
X                      = 0
Y                      = 50
Z                      = 0
AZIMUTH                = 180
CONSTRUCTION           = WALL-2
TILT                   = 180.0000   ..   $
REFERENCE FROM BUILDING ENERGY SIMULATION VOL.
23, No.6, PAGE 21 WINKELMANN MEMO

TOP-1                  = EXTERIOR-WALL
HEIGHT                 = 30.39
WIDTH                  = 104
X                      = -2
Y                      = -3.95
Z                      = 6.73
AZIMUTH                = 180
CONSTRUCTION           = ROOF-1
TILT                   = 17.7400   ..    $ DOE2
DEFAULTS

TOP-2                  = EXTERIOR-WALL
HEIGHT                 = 36.35
WIDTH                  = 104
X                      = 102
Y                      = 52.25
Z                      = 6.55
AZIMUTH                = 0
CONSTRUCTION           = ROOF-1
TILT                   = 32.6200   ..   $ DOE2
DEFAULTS

 $---HOURLY REPORTS---$

PLTSCH  = SCHEDULE   THRU JAN 14 (ALL) (1,24)
(1)
                     THRU AUG 9 (ALL) (1,24) (1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER1 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (1, 4, 6)   ..  $
CLEARNESS NUMBER, DRY BULB TEMPERATURE (°F),
CLOUD AMOUNT (0 TO 10) FROM REFERENCE PT1
III.101

PLOTER2 = REPORT-BLOCK
          VARIABLE-TYPE = BUILDING
          VARIABLE-LIST = (1, 2, 19, 20, 37)
.. $ BUILDING HEATING LOAD (SENSIBLE), BUILDING
HEATING LOAD (LATENT), BUILDING COOLING LOAD
(SENSIBLE), BUILDING COOLING LOAD (LATENT),
BUILDING ELECTRIC TOTAL FROM REFERENCE PT1
III.103 AND III.104

LDS-REP-1 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH
            REPORT-BLOCK    = (PLOTER1, PLOTER2)
            OPTION          = PRINT   ..

END  ..
COMPUTE  LOADS   ..

INPUT SYSTEMS   INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
```

```
              OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

              SYSTEMS-REPORT  SUMMARY = (ALL-
SUMMARY)
                              VERIFICATION
= (SV-A)
                              REPORT-FREQUENCY
= HOURLY
                              HOURLY-DATA-SAVE
= NO-SAVE   ..

              $ SYSTEMS SCHEDULES

FAN-1         =DAY-SCHEDULE       (1,24) (1)
..
FAN-2         =DAY-SCHEDULE       (1,24) (1)
..
FAN-SCHED     =SCHEDULE           THRU DEC 31
(WD) FAN-1 (WEH) FAN-2  ..

HEAT-1      =DAY-SCHEDULE    (1,24) (68)    ..
HEAT-2      =DAY-SCHEDULE    (1,24) (68)    ..
HEAT-WEEK   =WEEK-SCHEDULE   (MON,FRI)  HEAT-1
(WEH)  HEAT-2   ..
HEAT-SCHED  =SCHEDULE        THRU DEC 31   HEAT-
WEEK   ..
COOLOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24)  (1)   ..
HEATOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24)  (1)   ..

COOL-1      =DAY-SCHEDULE    (1,24) (78)    ..
COOL-2      =DAY-SCHEDULE    (1,24) (78)    ..
COOL-WEEK   =WEEK-SCHEDULE   (MON,FRI)  COOL-1
(WEH)  COOL-2   ..
COOL-SCHED  =SCHEDULE        THRU DEC 31   COOL-
WEEK   ..
```

```
R1           =DAY-RESET-SCH   SUPPLY-HI=60
SUPPLY-LO=52
                              OUTSIDE-LO=30
OUTSIDE-HI=75  ..
SAT-RESET    =RESET-SCHEDULE  THRU DEC 31 (ALL)
R1  ..

                    $ SYSTEM DESCRIPTION

ZAIR          =ZONE-AIR      OA-CFM/PER=0  ..

CONTROL       =ZONE-CONTROL  DESIGN-HEAT-T=70
DESIGN-COOL-T=76
                             HEAT-TEMP-SCH= HEAT-
SCHED
                             COOL-TEMP-SCH= COOL-
SCHED
                             THERMOSTAT-
TYPE=REVERSE-ACTION  ..

                      $ FOLLOWING AIR FLOWS ARE
FROM RUN 3 SV-A REPORT,
                      $ DIVIDED BY ALTITUDE
MULTIPLIER

SPACE1-1      =ZONE          ZONE-AIR=ZAIR
SIZING-OPTION=ADJUST-LOADS
                             ZONE-CONTROL      =
CONTROL
                             ZONE-TYPE         =
CONDITIONED
                             BASEBOARD-RATING  =
0.00        $ BTU/HR
                             PANEL-LOSS-RATIO  =
0.00        $ BTU/BTU
                             EXHAUST-EFF       =
0.75   $ FRAC. OR MULT.
                             BASEBOARD-CTRL    =
OUTDOOR-RESET
```

```
                     THROTTLING-RANGE  =
1.00       $ R
                     ZONE-FAN-KW/FLOW  =
0.0003     $ KW/CFM
                     TERMINAL-TYPE     =
SVAV
                     ZONE-REPORTS     =
YES   ..

S-CONT      =SYSTEM-CONTROL  COOLING-SCHEDULE=
COOLOFF
                             HEATING-SCHEDULE=
HEATOFF
                             HEAT-SET-T=65
                             COOL-CONTROL=RESET
                             COOL-RESET-
SCH=SAT-RESET
                             MIN-SUPPLY-T=60 ..

S-FAN       =SYSTEM-FANS     FAN-SCHEDULE=FAN-
SCHED  FAN-CONTROL=SPEED
                             SUPPLY-STATIC=2.0
SUPPLY-EFF=.55
                             NIGHT-CYCLE-
CTRL=CYCLE-ON-ANY  ..

S-TERM      =SYSTEM-TERMINAL REHEAT-DELTA-T=58
                             MIN-CFM-RATIO=0.1
..

SYST-1      =SYSTEM          SYSTEM-TYPE=SUM
                             SUPPLY-CFM
= 7366
                             SYSTEM-CONTROL
= S-CONT
                             SYSTEM-FANS
= S-FAN
                             SYSTEM-TERMINAL
= S-TERM
```

```
                         $ ECONO-LIMIT-T
= 65
                         ZONE-NAMES
= (SPACE1-1)
                         HEAT-SOURCE
= ELECTRIC
                         ZONE-HEAT-SOURCE
= ELECTRIC
                         PREHEAT-SOURCE
= ELECTRIC
                         BASEBOARD-SOURCE
= ELECTRIC
                         VARIABLE-T
= ON
                         SIZING-RATIO
= 1.00 $ DOE-2.1 DEFAULT
                         HEAT-SIZING-RATIO
= 1.00 $ DOE-2.1 DEFAULT
                         COOL-SIZING-RATI0
= 1.00 $ DOE-2.1 DEFAULT
                         RETURN-AIR-PATH
= DIRECT
                         HUMIDIFIER-TYPE
= ELECTRIC
                         SHW-HP-SOURCE
= ZONE
                         MAX-HUMIDITY
= 100.00 $ PERCENT
                         MIN-HUMIDITY
= 0.00   $ PERCENT
                         PREHEAT-T
= 45     $ F
                         DESC-CTRL-MODE
= 0.00
                         DESC-DEW-SET
= 50.00  $ F
                         OA-CONTROL
= TEMP
```

```
                              SUPPLY-DELTA-T   =
3.37   $ R
                              SUPPLY-KW/FLOW   =
0.0011 $ KW/CFM
                              MOTOR-PLACEMENT =
IN-AIRFLOW
                              FAN-PLACEMENT    =
DRAW-THROUGH
                              MAX-FAN-RATIO    =
1.10   $ FRAC. OR MULT.
                              MIN-FAN-RATIO    =
0.300  $ FRAC. OR MULT.
                              NIGHT-VENT-CTRL =
NOT-AVAILABLE
                              NIGHT-VENT-DT    =
5.0    $ R
                              RATED-CCAP-FFLOW
= SDL-C80
                              COOL-CAP-FT
= SDL-C7
                              COOL-SH-FT
= SDL-C27
                              COIL-BF
= 0.0370 $ FRAC. OR MULT.
                              COIL-BF-FFLOW
= SDL-C37
                              COIL-BF-FT
= SDL-C47   ..

PLANT1    = PLANT-ASSIGNMENT  SYSTEM-NAMES =
(SYST-1) $ REFERENCE FROM THE IECC1107 FILE
                              DHW-TYPE     =
ELECTRIC
                              DHW-SCH      =
DHWSCH-1
                              DHW-GAL/MIN  =
0.03472   .. $CALCULATED FROM ASHRAE 90.1 USER'S
MANUAL PAGE 7-14
```

```
DHWSCH-1  = SCHEDULE  THRU JAN 14 (ALL) (1,24)
(1)
                          THRU AUG 9 (ALL) (1,24) (1)
                          THRU DEC 31 (ALL) (1,24)
(1)   ..

PLTSCH2  = SCHEDULE  THRU JAN 14 (ALL) (1,24)
(1)
                          THRU AUG 9 (ALL) (1,24) (1)
                          THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER3 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (8)   .. $ DRY BULB
TEMPERATURE (°F) FROM SUPLEMENT PAGE A.16

PLOTER4 = REPORT-BLOCK
          VARIABLE-TYPE = PLANT1
          VARIABLE-LIST = (1, 2, 3)   .. $ TOTAL
COOLING LOAD (Btu/hr), TOTAL HEATING LOAD
(Btu/hr), TOTAL ELECTRICAL LOAD (Kw) FROM
SUPLEMENT PAGE A.48

LDS-REP-2 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH2
            REPORT-BLOCK    = (PLOTER3, PLOTER4)
            OPTION          = PRINT   ..

END   ..
COMPUTE SYSTEMS   ..
INPUT PLANT     INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

PLANT1 = PLANT-ASSIGNMENT  ..
```

```
             PLANT-REPORT  SUMMARY=(PS-A, PS-E,
BEPS)  ..

                $ EQUIPMENT DESCRIPTION

                $ HOT-WATER BOILER

SBOIL1   =PLANT-EQUIPMENT  TYPE=HW-BOILER
SIZE=-999   .. $ AUTOSIZE

        PLANT-PARAMETERS  HERM-REC-COND-
TYPE=AIR  ..

                $ AIR-COOLED RECIPROCATING
CHILLER

CHIL1    =PLANT-EQUIPMENT  TYPE=HERM-REC-CHLR
SIZE=-999  .. $ AUTOSIZE

 PLANT-COSTS      PROJECT-LIFE=25  DISCOUNT-
RATE=5 ..
 ENERGY-RESOURCE  RESOURCE=ELECTRICITY  ..
 ENERGY-RESOURCE  RESOURCE=NATURAL-GAS
ENERGY/UNIT=100000
                  UNIT-NAME=THERMS   ..

END  ..
COMPUTE PLANT   ..
STOP ..
```

This is the input file for Denver that uses SYSTEM-TYPE=VAVS

```
$TYPE OF BUILDING
$SAMPLE1E-RUN3A WITH MODIFICATION
$TEST CASE ONE SIX ZONE MODEL

$FILE NAME = 01A1.INP


$************************************************
********************************
$       PROGRAM:            DOE-2 SIMULATION
INPUT FILE
$
$       LANGUAGE:           DOE-2.1E BDL VERSION
110
$
$       SPONSOR:            National Science
Foundation
$
$       COPYRIGHT:          NSF, 2010.
$
$
$       DEVELOPER:          (PI) MARK J CLAYTON
$                           Professor
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-2300
$
$                           (Co-PI) JEFF HABERL
Ph.D, P.E.
$                           Professor
$                           Department of
Architecture
$                           Energy Systems
Laboratory
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-6065
```

```
$                                                           $*********************************************
$                              (Co-PI) WEI YAN              ******************************
$                              Assistant Professor
$                              Department of
Architecture
$                              Texas A&M
University, College Station, TX                             $                  -----------------------------
$                              PHONE: (979)845-0584         -------------------------
$                                                           $                 !
$       STUDENTS   :           JOSE LUIS BERMUDEZ           !
ALCOCER                                                     $                 !
$                              Ph.D. student                !
$                              Department of                $                 !
Architecture                                                !
$                              Texas A&M                    $                 !
University, College Station, TX                             !
$                                                           $                 !
$                              SANDEEP KOTA                 !
$                              Ph.D. student                $                 !
$                              Department of                !
Architecture                                                $                 !
$                              Texas A&M                    !
University, College Station, TX                             $                 !
$                                                           !
$                              JONG BUM KIM                 $                 !                     SPACE1-1
$                              Ph.D. student                !
$                              Department of                $                 !
Architecture                                                !
$                              Texas A&M                    $                 !
University, College Station, TX                             !
$                                                           $                 !
$                              WOONSEONG JEONG              !
$                              Ph.D. student                $                 !
$                              Department of                !
Architecture                                                $                 !
$                              Texas A&M                    !
University, College Station, TX                             $                 !
$                                                           !
```

```
$                 !
!
$                 !
!
$                 ------------------------------
-------------------------

INPUT LOADS  INPUT-UNITS = ENGLISH        $DOE-2
DEFAULT(OR METRIC)
             OUTPUT-UNITS = ENGLISH  ..   $DOE-2
DEFAULT(OR METRIC)

TITLE
LINE-1 *NSF PROJECT *
LINE-2 *TEST CASE-1 *
LINE-3 *ONE-ZONE MODEL* ..

RUN-PERIOD    FEB 3 2010 THRU FEB 3 2010
              AUG 25 2010 THRU AUG 25 2010
              JAN 1  2010 THRU DEC 31 2010
..

ABORT         ERRORS  ..
DIAGNOSTIC    DEFAULTS  ..        $ ADDED
COMMAND TO PRINT ALL THE DEFAULTS

LOADS-REPORT
SUMMARY  = (ALL-SUMMARY)          $ ADDED
COMMAND TO PRINT ALL THE LOADS SUMMARY REPORTS
VERIFICATION = (ALL-VERIFICATION) $ ADDED
COMMAND TO PRINT ALL THE LOADS VERIFICATION
REPORTS
REPORT-FREQUENCY      = HOURLY       $ DEFAULTS
FOR LOADS-REPORT
HOURLY-DATA-SAVE      = NO-SAVE   .. $ DEFAULTS
FOR LOADS-REPORT
```

```
$******************************DESIGN
DAYS*******************************

$ DENVER DESIGN DAYS.  DRY-BULB AND DEW POINT
TEMPERATURES FROM 1993 ASHRAE HANDBOOK (CHAPTER
24)

WINTER1=DESIGN-DAY                   $ ALL VALUES
ARBITRARY
          DRYBULB-HI= 1              $ (DEG F)
          DRYBULB-LO= 1              $ (DEG F)
          HOUR-HI= 13                $ (HOURS)
          HOUR-LO= 1                 $ (HOURS)
          DEWPT-HI= 32               $ (DEG F)
          DEWPT-LO= 32               $ (DEG F)
          DHOUR-HI= 15               $ (HOURS)
          DHOUR-LO=3                 $ (HOURS)
          WIND-SPEED= 7              $ (KNOTS)
          WIND-DIR= 8                $
0=NORTH,1=NNE ...
          CLOUD-AMOUNT= 0            $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 1              $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6             $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 77  ..           $ (DEG F)
FROM REFERENCE PART II PAGE VIII.93

SUMMER1=DESIGN-DAY                   $ ALL VALUES
ARBITRARY
          DRYBULB-HI= 91             $(DEG F)
          DRYBULB-LO= 91             $(DEG F)
          HOUR-HI= 13                $(HOURS)
          HOUR-LO= 3                 $(HOURS)
          DEWPT-HI= 59               $(DEG F)
          DEWPT-LO= 59               $(DEG F)
          DHOUR-HI= 15               $(HOURS)
```

```
          DHOUR-LO= 5             $(HOURS)
          WIND-SPEED= 5           $(KNOTS)
          WIND-DIR= 6             $
0=NORTH,1=NNE ...
          CLOUD-AMOUNT= 0         $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 0           $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6          $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 81  ..        $(DEG F) FROM
REFERENCE PART II PAGE VIII.93

$ ****************************************
BUILDING LOCATION INFORMATION
************************************************
**********


$ THE LOCATION INFORMATION LATITUDE/ LONGITUDE
AND ALTITUDE HAVE BEEN CHANGED FROM SAMP1E RUN3A
TO RUN THE SIMULATION FOR THE
$ DENVER WEATHER FILE.

BUILDING-LOCATION                $ BUILDING
LOCATION INPUT COMMAND
LATITUDE              = 39.83   $ LATITUDE  FOR
CITY OF DENVER
LONGITUDE             = 104.65   $ LONGITUDE FOR
CITY OF DENVER
ALTITUDE              = 5413.00  $ ALTITUDE FOR
CITY OF DENVER
HOLIDAY               = YES     $ DOE-2.1E
DEFAULT FOR HOLIDAYS = YES (USA-NATIONAL
HOLIDAYES)
TIME-ZONE             = 7       $ TIME ZONE FOR
THE CITY OF DENVER AZIMUTH              = 0
$ BUILDING AZIMUTH / SAMP1E RUN 3A  AZIMUTH =
30/ TESTCASE= 0
DAYLIGHT-SAVINGS      = YES     $ OPTIONS FOR
DAYLIGHT SAVINGS DOE-2.1E  DEFAULTS=YES
GROSS-AREA            = 5000    $ GROSS FLOOR
AREA OF THE CONDITIONED SPACE OF THE BUILDING
HEAT-PEAK-PERIOD      = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
COOL-PEAK-PERIOD      = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
ATM-MOISTURE          =
(0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7
)
                                $ UNUSED DOE-
21.E DEFAULTS CALCULATED HOURLY FROM DEWPOINT
TEMP BY
ATM-TURBIDITY  =
(0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.
12,0.12,0.12)
                                $ UNUSED DOE-
21.E DEFAULTS USED IF WEATHER FILE DO NOT HAVE
SOLAR DATA

X-REF                 = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
Y-REF                 = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
SHIELDING-COEF        = 0.2400  $ DOE-2
DEFAULT,THIS COEFFICIENT USED IN SHERMAN
GRIMSRUD INFILTRATION METHOD

TERRAIN-PAR1          = 0.8500  $ DOE-2 DEFAULT
IS A CONSTANT. USED TO MODIFY THE FREE STREAM
WIND SPEED TO ACCOUNT FOR GROUND ROUGHNESS AND
HEIGHT ABOVE GROUND LEVEL AT THE BUILDING SITE
TERRAIN-PAR2          = 0.2000  $ DOE-21.E
DEFAULTS IS A CONSTANT USED TO MODIFY THE FREE
STREAM WIND SPEED TO ACCOUNT FOR GROUND
```

```
ROUGHNESS AND HEIGHT ABOVE GROUND LEVEL AT THE
BUILDING SITE.

WS-TERRAIN-PAR1       = 1.0000  $ DOE-21.E
DEFAULTS IS A CONSTANT CORRESPONDING TO TERRAIN-
PART1, BUT FOR THE LOCATION OF THE WIND SPEED
MEASUREMENT; I.E., THE WEATHER STATION.
WS-TERRAIN-PAR2       = 0.1500  $ UNUSED DOE-
21.E DEFAULTS IS A CONSTANT CORRESPONDING TO
TERRAIN-PART2, BUT FOR THE LOCATION OF THE WIND
SPEED MEASUREMENT; I.E., THE WEATHER STATION.
WS-HEIGHT-LIST        = (33.0)  $ DOE-21.E
DEFAULTS
SOLAR-REFL-CALC       = NO-CALC $ DOE-21.E
DEFAULTS
SURF-TEMP-CALC        = NO   ..


$*************************************PARAMETERS
***********************************************
*
$***********SCHEDULES***********$

          B-SH-1 =SCHEDULE           THRU JAN 1
(ALL) (1,24)(1)
                                     THRU DEC 31
(ALL) (1,24)(1)  ..

$ BUILDING SHADES (REFERENCE FROM IECC1107.INP
FILE) $

BD1 = BUILDING-SHADE
           X = 0 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                 $(FT)
           WIDTH = 5.0                   $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD2 = BUILDING-SHADE
           X = 0 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD3 = BUILDING-SHADE
           X = 20 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                  $(FT)
           WIDTH = 5.0                    $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0             $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..     $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD4 = BUILDING-SHADE
```

```
           X = 20 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD5 = BUILDING-SHADE
           X = 40 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD6 = BUILDING-SHADE
           X = 40 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD7 = BUILDING-SHADE
           X = 60 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD8 = BUILDING-SHADE
           X = 60 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD9 = BUILDING-SHADE
           X = 80 Y = 0 Z = 0
$COORDINATES
```

```
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD10 = BUILDING-SHADE
           X = 80 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD11 = BUILDING-SHADE
           X = 100 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD12 = BUILDING-SHADE
           X = 100 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD13 = BUILDING-SHADE
           X = 0 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                      $(FT)
           WIDTH  = 4                       $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD14 = BUILDING-SHADE
           X = 8 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                      $(FT)
           WIDTH  = 4                       $(FT)
```

```
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD15 = BUILDING-SHADE
          X = 12 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                      $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD16 = BUILDING-SHADE
          X = 16 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                      $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD17 = BUILDING-SHADE
          X = 20 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                      $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD18 = BUILDING-SHADE
          X = 24 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                      $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD19 = BUILDING-SHADE
          X = 28 Y = 0 Z = 18.5
$COORDINATES
```

```
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0                $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..        $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD20 = BUILDING-SHADE
          X = 32 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0                $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..        $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD21 = BUILDING-SHADE
          X = 36 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0                $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..        $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD22 = BUILDING-SHADE
          X = 40 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0                $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..        $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD23 = BUILDING-SHADE
          X = 44 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0                $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..        $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD24 = BUILDING-SHADE
```

```
          X = 48 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD25 = BUILDING-SHADE
          X = 52 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD26 = BUILDING-SHADE
          X = 56 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD27 = BUILDING-SHADE
          X = 60 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD28 = BUILDING-SHADE
          X = 64 Y = 0 Z = 18.5
$COORDINATES
          HEIGHT = 24
$(FT)
          WIDTH  = 4                        $(FT)
          AZIMUTH = 180
$(DEGREES)
         TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
         TILT = 17.74
$(DEGREES),DEFAULT = 90
         SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING
```

```
BD29 = BUILDING-SHADE
           X = 68 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD30 = BUILDING-SHADE
           X = 72 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD31 = BUILDING-SHADE
           X = 76 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD32 = BUILDING-SHADE
           X = 80 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..    $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD33 = BUILDING-SHADE
           X = 84 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                    $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0            $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
```

```
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD34 = BUILDING-SHADE
           X = 88 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD35 = BUILDING-SHADE
           X = 92 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD36 = BUILDING-SHADE
           X = 96 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING


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*   BUILDING DESCRIPTION
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$
************************************************
******   MATERIALS
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*************
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BUILTUP-ROOFING-MAT   = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS             = 0.0313     $(FT)
CONDUCTIVITY          = 0.0939
$(BTU.FT/HR.FT^2.F)
DENSITY               = 70         $(LB/FT^3)
SPECIFIC-HEAT         = 0.35  ..   $(BTU/LB.F)

ROOF-GRAVEL-MAT       = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.7 MATERIALS
LIBRARY)
THICKNESS             = 0.0417     $(FT)

CONDUCTIVITY          = 0.834
$(BTU.FT/HR.FT^2.F)
DENSITY               = 55         $(LB/FT^3)
SPECIFIC-HEAT         = 0.4  ..    $(BTU/LB.F)

POLY-EXP            = MATERIAL     $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS             = 0.4166     $(FT)
CONDUCTIVITY          = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY               = 1.8        $(LB/FT^3)
SPECIFIC-HEAT         = 0.29  ..   $(BTU/LB.F)

BRICK-4"              = MATERIAL   $
DOE2.1E(FROM REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS             = 0.3333     $(FT)
CONDUCTIVITY          = 0.4167
$(BTU.FT/HR.FT^2.F)
DENSITY                = 120        $(LB/FT^3)
SPECIFIC-HEAT          = 0.2   ..   $(BTU/LB.F)

MIN-WOOL-FIB          = MATERIAL    $
DOE2.1E(FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS             = 0.5108      $ BATT, R-19
CONDUCTIVITY          = 0.0250
$(BTU.FT/HR.FT^2.F)
DENSITY               = 0.60        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

GYPSUM                = MATERIAL    $
DOE2.1E(HOLLOW GYPSUM BOARD FROM REFERENCE 2ND
PART X.B.6 MATERIALS LIBRARY)
THICKNESS             = 0.0417      $(FT)
CONDUCTIVITY          = 0.0926
$(BTU.FT/HR.FT^2.F)
DENSITY               = 49.0        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

AIR-LAYER-HALF-INCH  = MATERIAL   $ DOE2.1E(AIR
LAYER, ¾ IN. OR LESS FOR VERTICAL WALLS FROM
REFERENCE 2ND PART X.B.11 MATERIALS LIBRARY)
RESISTANCE            = 0.9  ..
$(HR.FT^2.F/BTU)

PLASTIC-FILM-SEAL     = MATERIAL   $
DOE2.1E(BUILDING PAPER TYPE FROM REFERENCE 2ND
PART X.B.2 MATERIALS LIBRARY) REPRESENTING TAR-
PAPER
RESISTANCE            = 0.01  ..
$(HR.FT^2.F/BTU)

PLYWOOD-HALF-INCH     = MATERIAL   $ DOE2.1E(FROM
REFERENCE 2ND PART X.B.7 MATERIALS LIBRARY)
THICKNESS             = 0.0417     $(FT)
CONDUCTIVITY          = 0.0667
$(BTU.FT/HR.FT^2.F)
```

```
DENSITY              = 34.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.29  ..   $(BTU/LB.F)

SOFT-WOOD            = MATERIAL    $ DOE2.1E(3/4
IN. FROM REFERENCE 2ND PART X.B.8 MATERIALS
LIBRARY)
THICKNESS            = 0.0625      $(FT)
CONDUCTIVITY         = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY              = 34          $(LB/FT^3)
SPECIFIC-HEAT        = 0.33  ..    $(BTU/LB.F)

SOIL-12IN            = MATERIAL    $ SOIL LAYER
(FROM BUILDING ENERGY SIMULATION VOL. 23, No.6,
PAGES 21-22 WINKELMANN MEMO)
THICKNESS            = 1.0         $(FT)
CONDUCTIVITY         = 1.0
$(BTU.FT/HR.FT^2.F)
DENSITY              = 115         $(LB/FT^3)
SPECIFIC-HEAT        = 0.1  ..     $(BTU/LB.F)

CONCRETE-HE-WEIGHT   = MATERIAL    $ DOE2.1E(4
IN., DRIED AGGREGATE, 140 LB. FROM REFERENCE 2ND
PART X.B.3 MATERIALS LIBRARY)
THICKNESS            = 0.33        $(FT)
CONDUCTIVITY         = 0.7576
$(BTU.FT/HR.FT^2.F)
DENSITY              = 140.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

CONCRETE-BLOCK-8"    = MATERIAL    $
DOE2.1E(CONCRETE FILLED FROM REFERENCE 2ND PART
X.B.6 MATERIALS LIBRARY)
THICKNESS            = 0.6667      $(FT)
CONDUCTIVITY         = 0.4359
$(BTU.FT/HR.FT^2.F)
DENSITY              = 115.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

CONCRETE-LI-WEIGHT   = MATERIAL    $ DOE2.1E(4
IN., 80 LB. FROM REFERENCE 2ND PART X.B.5
MATERIALS LIBRARY)
THICKNESS            = 0.33        $(FT)
CONDUCTIVITY         = 0.2083
$(BTU.FT/HR.FT^2.F)
DENSITY              = 80.0        $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

POLY-EXP-2            = MATERIAL   $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS             = 0.3333     $(FT)
CONDUCTIVITY          = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY               = 1.8        $(LB/FT^3)
SPECIFIC-HEAT         = 0.29  ..   $(BTU/LB.F)

MINERAL-WOOL1        = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
THICKNESS            = 0.2917       $(FT)
CONDUCTIVITY         = 0.027
$(BTU.FT/HR.FT^2.F)
DENSITY              = 0.6          $(LB/FT^3)
SPECIFIC-HEAT        = 0.2   ..     $(BTU/LB.F)

SOFT-WOOD1           = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
THICKNESS            = 0.2083      $(FT)
CONDUCTIVITY         = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY              = 32          $(LB/FT^3)
SPECIFIC-HEAT        = 0.33  ..    $(BTU/LB.F)

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$
************************************************
*****   LAYERS
************************************************
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$***********************************************
************************************************
*********************************

WA-1-2            = LAYERS          $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800          $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL          = (AIR-LAYER-HALF-INCH,BRICK-
4",PLASTIC-FILM-SEAL,
PLYWOOD-HALF-INCH,MIN-WOOL-FIB,GYPSUM,AIR-LAYER-
HALF-INCH)..  $ MATERIALS FROM OUTSIDE TO INSIDE

WA-1-3            = LAYERS          $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800          $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL          = (POLY-EXP-2,CONCRETE-LI-
WEIGHT)..  $ MATERIALS FROM OUTSIDE TO INSIDE

ROO-1            = LAYERS           $ LAYERS FOR
THE ROOF CONSTRUCTION
INSIDE-FILM-RES = 0.76              $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL         = (ROOF-GRAVEL-MAT,BUILTUP-
ROOFING-MAT,POLY-EXP,SOFT-WOOD)..
$ MATERIALS FROM OUTSIDE TO INSIDE

DOOR-LAY1         = LAYERS            $ REFERENCED
FROM IECC1107 FILE
MATERIAL          = (GYPSUM,MINERAL-WOOL1,
      SOFT-WOOD1,GYPSUM)   ..

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$
************************************************
*****   CONSTRUCTIONS
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*********************************

WALL-1            = CONSTRUCTION     $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-2           $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000    ..     $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

WALL-2            = CONSTRUCTION     $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-3           $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000    ..     $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

ROOF-1            = CONSTRUCTION     $ ROOF
CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = ROO-1            $ LAYERS OF
THE ROOF CONSTRUCTION (LAYERED CONSTRUCTION)
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
```

```
ROUGHNESS         = 3.0000  ..       $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

DOOR-1            = CONSTRUCTION   $ REFERENCED
FROM IECC1107 FILE)
LAYERS            = DOOR-LAY1
U                 = 0.2  ..        $ IECC
2001(RESIDENTIAL BUILDING)(BTU/HR.FT^2.F)

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************************************************
*****   WINDOWS/DOORS
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*************
$
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$ THE SIMULATION TOOL (DOE-2.1E) CAN ACCEPT
CUSTOM WINDOWS DESIGNED USING WINDOWS-5 (LBNL)
PROGRAM AS A
$ REASON WINDOWS AND DOORS ARE MODELED USING
WINDOWS-5 (LBNL) PROGRAM FOR CONSISTANCY .

W-1               =       GLASS-TYPE
$ CUSTOM WINDOW FOR LOWER SOUTH FRONT WALL AND
BACK WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001            $ GLASS
TYPE CODE
PANES             =       1.0000          $ FROM
THE WINDOWS-5 LIBRARY
GLASS-CONDUCTANC =       1.4700          $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS         =       0.9000          $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS      =       0.8400          $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS     =       0.8400          $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000          $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS         =       0.7000          $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..       $ FROM
THE WINDOWS-5 LIBRARY

W-2               =       GLASS-TYPE
$ CUSTOM WINDOW FOR UPPER SOUTH FRONT WALL
WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001            $ GLASS
TYPE CODE
PANES             =       1.0000          $ FROM
THE WINDOWS-5 LIBRARY
GLASS-CONDUCTANC =       1.4700          $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS         =       0.9000          $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS      =       0.8400          $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS     =       0.8400          $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000          $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS         =       0.7000          $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..       $ FROM
THE WINDOWS-5 LIBRARY

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```

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$
*************************************************
*****   OCCUPANCY SCHEDULE
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*****
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OC-1             = DAY-SCHEDULE  (1,8) (0.0)
                                 (9,11) (1.0)
                                 (12,14)
(0.8,0.4,0.8)
                                 (15,18) (1.0)
                                 (19,21)
(0.5,0.1,0.1)
                                 (22,24) (0.0)
..
OC-2            = DAY-SCHEDULE   (1,24) (0.0)
..
OC-WEEK         = WEEK-SCHEDULE  (WD) OC-1 (WEH)
OC-2    ..
OCCUPY-1        = SCHEDULE       THRU DEC 31 OC-
WEEK     ..

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$
*************************************************
*****   LIGHTING SCHEDULE
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******
$
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```

```
LT-1            =DAY-SCHEDULE      (1,8) (0.05)
                                   (9,18) (1.0)
$OFFICE2 LIGHTING SCHEDULE HAS BEEN SET TO ONE
DURING OFFICE HOURS.
                                   (19,24)
(0.05)..

LT-2            =DAY-SCHEDULE      (1,24) (0.05)
..

LT-WEEK         =WEEK-SCHEDULE     (MON,FRI) LT-
1   (WEH) LT-2  ..

LIGHTS-1        =SCHEDULE          THRU DEC 31
LT-WEEK  ..

$
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$
*************************************************
*****   EQUIPMENT SCHEDULE
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*****
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EQ-1            =DAY-SCHEDULE     (1,8) (0.02)
                                  (9,14)
(0.4,0.9,0.9,0.9,0.9,0.9)
                                  (15,20)
(0.8,0.7,0.5,0.5,0.3,0.3)
                                  (21,24) (0.02)
..
```

```
EQ-2            =DAY-SCHEDULE      (1,24) (0.2)
..
EQ-WEEK         =WEEK-SCHEDULE     (MON,FRI) EQ-1
(WEH) EQ-2  ..
EQUIP-1         =SCHEDULE           THRU DEC 31
EQ-WEEK  ..

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************************************************
*****   INFILTRATION SCHEDULE
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*****   GENERAL SPACE DEFINITIONS
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OFFICE                = SPACE-CONDITIONS
..
```

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$
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*****   SPECIFIC SPACE DETAILS
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**

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$
************************************************
*****         SPACE1-1
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**
$
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***********************************

SPACE1-1                 = SPACE
ZONE-TYPE                = CONDITIONED $ DOE2
DEFAULTS
AREA                     = 5000
VOLUME                   = 70000
X                        = 0.0000
Y                        = 0.0000      $ DOE2
DEFAULTS
Z                        = 10.0000     $ DOE2
DEFAULTS
```

```
AZIMUTH                 = 0.0000       $ DOE2
DEFAULTS
MULTIPLIER              = 1.0000       $ DOE2
DEFAULTS
FLOOR-WEIGHT            = 70           $ IECC
2001,402.1.3.3,DOE2 DEFAULTS IS 70
NUMBER-OF-PEOPLE        = 50
PEOPLE-SCHEDULE         = OCCUPY-1
PEOPLE-HEAT-GAIN        = 400          $ DOE2
DEFAULTS
PEOPLE-HG-LAT           = 130.3        $ DOE2
DEFAULTS
PEOPLE-HG-SENS          = 252.2        $ DOE2
DEFAULTS
EQUIP-SCHEDULE          = EQUIP-1
EQUIPMENT-W/SQFT        = 1            $ DOE2
DEFAULTS
AIR-CHANGES/HR          = 0.25         $ DOE2
DEFAULTS
TEMPERATURE             = (73)         $ DOE2
DEFAULTS
SOURCE-TYPE             = ELECTRIC     $ DOE2
DEFAULTS
SOURCE-POWER            = 0.0000       $ DOE2
DEFAULTS
EQUIP-LATENT            = 0.0000       $ DOE2
DEFAULTS
EQUIP-SENSIBLE          = 1.0000       $ DOE2
DEFAULTS
SOURCE-LATENT           = 0.5          $ DOE2
DEFAULTS
SOURCE-SENSIBLE         = 0.4          $ DOE2
DEFAULTS
FLOOR-MULTIPLIER        = 1.0000       $ DOE2
DEFAULTS
LIGHTING-SCHEDULE       = LIGHTS-1
LIGHTING-TYPE           = REC-FLUOR-RV
LIGHT-TO-SPACE          = 0.80
LIGHTING-W/SQFT         = 1.5
DAYLIGHTING             = YES          $ DAYLIGHING
OPTION IS SWITCHED ON
LIGHT-REF-POINT1        = (25,25,2.7) $ LOCATION OF
THE FIRST DAYLIGHT SENSOR
LIGHT-REF-POINT2        = (75,25,2.7) $ LOCTION OF
THE SECOND DAYLIGHT SENSOR
ZONE-FRACTION1          = 0.5          $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 1
ZONE-FRACTION2           = 0.5          $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 2
LIGHT-SET-POINT1         = 50           $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 1
LIGHT-SET-POINT2         = 50           $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 2
LIGHT-CTRL-TYPE1         = CONTINUOUS   $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 1
LIGHT-CTRL-TYPE2         = CONTINUOUS   $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 2
MIN-POWER-FRAC           = 0            $ LOWEST
INPUT POWER FRACTION FOR CONTINUOUSLY DIMMABLE
LIGHING CONTROL SYSTEM
MIN-LIGHT-FRAC           = 0   ..       $ SPECIFIES
THE FRACTIONAL LIGHT OUTPUT THAT A CONTINUOUSLY
DIMNMABLE
                                        $ LIGHTING
CONTROL SYSTEM PRODUCES AT THE MINIMUM
FRACTIONAL INPUT POWER GIVEN BY MIN-POWER-FRAC

FRONT-1                  = EXTERIOR-WALL
HEIGHT                   = 8
WIDTH                    = 100
X                        = 0
Y                        = 0
Z                        = 0
AZIMUTH                  = 180
CONSTRUCTION             = WALL-1
```

```
TILT                    = 90.0000   ..   $ DOE2
DEFAULTS

WF-1                    = WINDOW
WIDTH                   = 45
HEIGHT                  = 4.0000
X                       = 52.5
Y                       = 3.0000
GLASS-TYPE              = W-1   ..

FRONT-2                 = EXTERIOR-WALL
HEIGHT                  = 8
WIDTH                   = 100
X                       = 0
Y                       = 25
Z                       = 16
AZIMUTH                 = 180
CONSTRUCTION            = WALL-1
TILT                    = 90.0000   ..   $ DOE2
DEFAULTS

WF-2                    = WINDOW
WIDTH                   = 90
HEIGHT                  = 3.0000
X                       = 5
Y                       = 4.0000
GLASS-TYPE              = W-2   ..

PR1                     = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129


(100,0,0)(100,50,0)(100,50,8)(100,25,24)
(100,25,16)(100,0,8)  ..
RIGHT-1 = EXTERIOR-WALL   POLYGON = PR1
X                       = 100
Y                       = 0
Z                       = 0
CONSTRUCTION            = WALL-1   ..

DR-1                    = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                   = 3
HEIGHT                  = 7
X                       = 25
Y                       = 0
SETBACK = 0.0                          $(FT)
CONSTRUCTION            = DOOR-1
$MULTIPLIER             =             UNUSED
$OVERHANG-A             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE         = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D             = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D            = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF               = 0.0         USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
```

```
SKY-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS    = 10
INSIDE-VIS-REFL       = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-2                  = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                 = 3
HEIGHT                = 7
X                     = 22
Y                     = 0
SETBACK = 0.0                          $(FT)
CONSTRUCTION          = DOOR-1
$MULTIPLIER           =             UNUSED
$OVERHANG-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE       = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF             = 0.0         USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS    = 10
INSIDE-VIS-REFL       = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

BACK-1                = EXTERIOR-WALL
HEIGHT                = 8
WIDTH                 = 100
X                     = 100
Y                     = 50
Z                     = 0
AZIMUTH               = 0
CONSTRUCTION          = WALL-1
TILT                  = 90.0000   ..    $DEGREES

WB-1                  = WINDOW
WIDTH                 = 24
HEIGHT                = 4.0000
X                     = 11
Y                     = 3.0000
GLASS-TYPE            = W-1  ..

WB-2                  = WINDOW
WIDTH                 = 24
HEIGHT                = 4.0000
X                     = 65
Y                     = 3.0000
GLASS-TYPE            = W-1  ..
```

```
PL1                    = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129


(0,50,0)(0,0,0)(0,0,8)(0,25,16)
(0,25,24)(0,50,8)    ..
LEFT-1                 = EXTERIOR-WALL  POLYGON =
PL1
X                      = 0
Y                      = 50
Z                      = 0
CONSTRUCTION           = WALL-1   ..

DR-3                   = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                  = 3
HEIGHT                 = 7
X                      = 25
Y                      = 0
SETBACK = 0.0                         $(FT)
CONSTRUCTION           = DOOR-1
$MULTIPLIER            =            UNUSED
$OVERHANG-A            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE        = 0.0        DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A           = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B           = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H           = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D           = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF              = 0.0        USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR        = 0.5        $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR        = 0.5        $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS     = 10
INSIDE-VIS-REFL        = 0.0    ..      $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-4                   = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                  = 3
HEIGHT                 = 7
X                      = 22
Y                      = 0
SETBACK = 0.0                         $(FT)
CONSTRUCTION           = DOOR-1
$MULTIPLIER            =            UNUSED
$OVERHANG-A            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D            = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE        = 0.0        DOE-2
DEFAULT,UNUSED(DEGREES)
```

```
$LEFT-FIN-A            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF              = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR        = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR        = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS     = 10
INSIDE-VIS-REFL        = 0.0   ..         $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

FLOOR-1                = EXTERIOR-WALL
HEIGHT                 = 50
WIDTH                  = 100
X                      = 0
Y                      = 50
Z                      = 0
AZIMUTH                = 180
CONSTRUCTION           = WALL-2
TILT                   = 180.0000   ..   $
REFERENCE FROM BUILDING ENERGY SIMULATION VOL.
23, No.6, PAGE 21 WINKELMANN MEMO

TOP-1                  = EXTERIOR-WALL
HEIGHT                 = 30.39
WIDTH                  = 104
X                      = -2
Y                      = -3.95
Z                      = 6.73
AZIMUTH                = 180
CONSTRUCTION           = ROOF-1
TILT                   = 17.7400   ..    $ DOE2
DEFAULTS

TOP-2                  = EXTERIOR-WALL
HEIGHT                 = 36.35
WIDTH                  = 104
X                      = 102
Y                      = 52.25
Z                      = 6.55
AZIMUTH                = 0
CONSTRUCTION           = ROOF-1
TILT                   = 32.6200   ..   $ DOE2
DEFAULTS

 $---HOURLY REPORTS---$

PLTSCH  = SCHEDULE   THRU FEB 3 (ALL) (1,24) (1)
                     THRU AUG 25 (ALL) (1,24)
(1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER1 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (1, 4, 6)   ..  $
CLEARNESS NUMBER, DRY BULB TEMPERATURE (°F),
CLOUD AMOUNT (0 TO 10) FROM REFERENCE PT1
III.101

PLOTER2 = REPORT-BLOCK
          VARIABLE-TYPE = BUILDING
```

```
         VARIABLE-LIST = (1, 2, 19, 20, 37)
.. $ BUILDING HEATING LOAD (SENSIBLE), BUILDING
HEATING LOAD (LATENT), BUILDING COOLING LOAD
(SENSIBLE), BUILDING COOLING LOAD (LATENT),
BUILDING ELECTRIC TOTAL FROM REFERENCE PT1
III.103 AND III.104

LDS-REP-1 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH
            REPORT-BLOCK    = (PLOTER1, PLOTER2)
            OPTION          = PRINT   ..

END  ..
COMPUTE  LOADS   ..

INPUT SYSTEMS   INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

               SYSTEMS-REPORT  SUMMARY = (ALL-
SUMMARY)
                               VERIFICATION
= (SV-A)
                               REPORT-FREQUENCY
= HOURLY
                               HOURLY-DATA-SAVE
= NO-SAVE   ..

               $ SYSTEMS SCHEDULES

FAN-1          =DAY-SCHEDULE       (1,24) (1)
..
FAN-2          =DAY-SCHEDULE       (1,24) (1)
..
FAN-SCHED      =SCHEDULE           THRU DEC 31
(WD) FAN-1 (WEH) FAN-2  ..

HEAT-1      =DAY-SCHEDULE    (1,24) (68)    ..
HEAT-2      =DAY-SCHEDULE    (1,24) (68)    ..
HEAT-WEEK   =WEEK-SCHEDULE   (MON,FRI)  HEAT-1
(WEH)  HEAT-2   ..
HEAT-SCHED  =SCHEDULE        THRU DEC 31   HEAT-
WEEK   ..
COOLOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24) (1)  ..
HEATOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24) (1)  ..

COOL-1      =DAY-SCHEDULE    (1,24) (78)    ..
COOL-2      =DAY-SCHEDULE    (1,24) (78)    ..
COOL-WEEK   =WEEK-SCHEDULE   (MON,FRI)  COOL-1
(WEH)  COOL-2   ..
COOL-SCHED  =SCHEDULE        THRU DEC 31   COOL-
WEEK   ..

R1          =DAY-RESET-SCH   SUPPLY-HI=60
SUPPLY-LO=52
                             OUTSIDE-LO=30
OUTSIDE-HI=75  ..
SAT-RESET   =RESET-SCHEDULE  THRU DEC 31 (ALL)
R1  ..

                    $ SYSTEM DESCRIPTION

ZAIR         =ZONE-AIR      OA-CFM/PER=0  ..

CONTROL      =ZONE-CONTROL  DESIGN-HEAT-T=70
DESIGN-COOL-T=76
                            HEAT-TEMP-SCH= HEAT-
SCHED
                            COOL-TEMP-SCH= COOL-
SCHED
                            THERMOSTAT-
TYPE=REVERSE-ACTION  ..

                      $ FOLLOWING AIR FLOWS ARE
FROM RUN 3 SV-A REPORT,
```

```
                    $ DIVIDED BY ALTITUDE                                          SUPPLY-STATIC=2.0
MULTIPLIER                                              SUPPLY-EFF=.55
                                                                                   NIGHT-CYCLE-
SPACE1-1     =ZONE           ZONE-AIR=ZAIR              CTRL=CYCLE-ON-ANY  ..
SIZING-OPTION=ADJUST-LOADS
                             ZONE-CONTROL      =        S-TERM      =SYSTEM-TERMINAL REHEAT-DELTA-T=58
CONTROL                                                                            MIN-CFM-RATIO=0.1
                             ZONE-TYPE         =        ..
CONDITIONED
                             BASEBOARD-RATING  =        SYST-1      =SYSTEM        SYSTEM-TYPE=VAVS
0.00        $ BTU/HR                                                               SUPPLY-CFM
                             PANEL-LOSS-RATIO  =        = 7366
0.00        $ BTU/BTU                                                              SYSTEM-CONTROL
                             EXHAUST-EFF       =        = S-CONT
0.75   $ FRAC. OR MULT.                                                            SYSTEM-FANS
                             BASEBOARD-CTRL    =        = S-FAN
OUTDOOR-RESET                                                                      SYSTEM-TERMINAL
                             THROTTLING-RANGE  =        = S-TERM
1.00        $ R                                                                    ECONO-LIMIT-T
                             ZONE-FAN-KW/FLOW  =        = 65
0.0003      $ KW/CFM                                                               ZONE-NAMES
                             TERMINAL-TYPE     =        = (SPACE1-1)
SVAV                                                                               HEAT-SOURCE
                             ZONE-REPORTS     =         = ELECTRIC
YES   ..                                                                           ZONE-HEAT-SOURCE
                                                        = ELECTRIC
S-CONT       =SYSTEM-CONTROL  COOLING-SCHEDULE=                                    PREHEAT-SOURCE
COOLOFF                                                 = ELECTRIC
                              HEATING-SCHEDULE=                                    BASEBOARD-SOURCE
HEATOFF                                                 = ELECTRIC
                              HEAT-SET-T=65                                        VARIABLE-T
                              COOL-CONTROL=RESET        = ON
                              COOL-RESET-                                          SIZING-RATIO
SCH=SAT-RESET                                           = 1.00 $ DOE-2.1 DEFAULT
                              MIN-SUPPLY-T=60 ..                                   HEAT-SIZING-RATIO
                                                        = 1.00 $ DOE-2.1 DEFAULT
S-FAN        =SYSTEM-FANS     FAN-SCHEDULE=FAN-                                    COOL-SIZING-RATI0
SCHED  FAN-CONTROL=SPEED                                = 1.00 $ DOE-2.1 DEFAULT
```

```
= DIRECT

= ELECTRIC

= ZONE

= 100.00 $ PERCENT

= 0.00   $ PERCENT

= 45     $ F

= 0.00

= 50.00  $ F

= TEMP

3.37   $ R

0.0011 $ KW/CFM

IN-AIRFLOW

DRAW-THROUGH

1.10   $ FRAC. OR MULT.

0.300  $ FRAC. OR MULT.

NOT-AVAILABLE

5.0    $ R

= SDL-C80

= SDL-C7
```

```
RETURN-AIR-PATH

HUMIDIFIER-TYPE

SHW-HP-SOURCE

MAX-HUMIDITY

MIN-HUMIDITY

PREHEAT-T

DESC-CTRL-MODE

DESC-DEW-SET

OA-CONTROL

SUPPLY-DELTA-T  =

SUPPLY-KW/FLOW  =

MOTOR-PLACEMENT =

FAN-PLACEMENT   =

MAX-FAN-RATIO   =

MIN-FAN-RATIO   =

NIGHT-VENT-CTRL =

NIGHT-VENT-DT   =

RATED-CCAP-FFLOW

COOL-CAP-FT
```

```
                              COOL-SH-FT
= SDL-C27
                              COIL-BF
= 0.0370 $ FRAC. OR MULT.
                              COIL-BF-FFLOW
= SDL-C37
                              COIL-BF-FT
= SDL-C47   ..

PLANT1    = PLANT-ASSIGNMENT  SYSTEM-NAMES =
(SYST-1) $ REFERENCE FROM THE IECC1107 FILE
                              DHW-TYPE     =
ELECTRIC
                              DHW-SCH      =
DHWSCH-1
                              DHW-GAL/MIN  =
0.03472   .. $CALCULATED FROM ASHRAE 90.1 USER'S
MANUAL PAGE 7-14

DHWSCH-1  = SCHEDULE  THRU FEB 3 (ALL) (1,24)
(1)
                     THRU AUG 25 (ALL) (1,24)
(1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLTSCH2  = SCHEDULE  THRU FEB 3 (ALL) (1,24) (1)
                     THRU AUG 25 (ALL) (1,24)
(1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER3 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (8)   .. $ DRY BULB
TEMPERATURE (°F) FROM SUPLEMENT PAGE A.16

PLOTER4 = REPORT-BLOCK
          VARIABLE-TYPE = PLANT1
```

```
          VARIABLE-LIST = (1, 2, 3)    .. $ TOTAL
COOLING LOAD (Btu/hr), TOTAL HEATING LOAD
(Btu/hr), TOTAL ELECTRICAL LOAD (Kw) FROM
SUPLEMENT PAGE A.48

LDS-REP-2 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH2
            REPORT-BLOCK    = (PLOTER3, PLOTER4)
            OPTION          = PRINT   ..

END   ..
COMPUTE SYSTEMS   ..
INPUT PLANT     INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

PLANT1 = PLANT-ASSIGNMENT  ..

              PLANT-REPORT  SUMMARY=(PS-A, PS-E,
BEPS)  ..

                $ EQUIPMENT DESCRIPTION

                $ HOT-WATER BOILER

SBOIL1   =PLANT-EQUIPMENT  TYPE=HW-BOILER
SIZE=-999   .. $ AUTOSIZE

          PLANT-PARAMETERS  HERM-REC-COND-
TYPE=AIR  ..

                $ AIR-COOLED RECIPROCATING
CHILLER

CHIL1    =PLANT-EQUIPMENT  TYPE=HERM-REC-CHLR
SIZE=-999  .. $ AUTOSIZE
```

```
 PLANT-COSTS      PROJECT-LIFE=25  DISCOUNT-
RATE=5 ..
 ENERGY-RESOURCE  RESOURCE=ELECTRICITY  ..
 ENERGY-RESOURCE  RESOURCE=NATURAL-GAS
ENERGY/UNIT=100000
                  UNIT-NAME=THERMS   ..

END  ..
COMPUTE PLANT   ..
STOP ..
```

This is the input file for Denver that uses SYSTEM-TYPE=SUM

```
$TYPE OF BUILDING
$SAMPLE1E-RUN3A WITH MODIFICATION
$TEST CASE ONE SIX ZONE MODEL

$FILE NAME = 01A1.INP


$************************************************
******************************
$       PROGRAM:           DOE-2 SIMULATION
INPUT FILE
$
$       LANGUAGE:          DOE-2.1E BDL VERSION
110
$
$       SPONSOR:           National Science
Foundation
$
$       COPYRIGHT:         NSF, 2010.
```

```
$
$
$       DEVELOPER:          (PI) MARK J CLAYTON
$                           Professor
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-2300
$
$                           (Co-PI) JEFF HABERL
Ph.D, P.E.
$                           Professor
$                           Department of
Architecture
$                           Energy Systems
Laboratory
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-6065
$
$                           (Co-PI) WEI YAN
$                           Assistant Professor
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$                           PHONE: (979)845-0584
$
$       STUDENTS   :        JOSE LUIS BERMUDEZ
ALCOCER
$                           Ph.D. student
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$                           SANDEEP KOTA
$                           Ph.D. student
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$                           JONG BUM KIM
$                           Ph.D. student
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$                           WOONSEONG JEONG
$                           Ph.D. student
$                           Department of
Architecture
$                           Texas A&M
University, College Station, TX
$
$*********************************************************
*******************************


$                   ------------------------------
-------------------------
$                   !
!
$                   !
!
$                   !
!
$                   !
!
$                   !
!
$                   !
!
```

```
$                  !
!                                                                  ABORT         ERRORS  ..
$                  !                                               DIAGNOSTIC    DEFAULTS  ..        $ ADDED
!                                                                  COMMAND TO PRINT ALL THE DEFAULTS
$                  !                     SPACE1-1
!                                                                  LOADS-REPORT
$                  !                                               SUMMARY  = (ALL-SUMMARY)          $ ADDED
!                                                                  COMMAND TO PRINT ALL THE LOADS SUMMARY REPORTS
$                  !                                               VERIFICATION = (ALL-VERIFICATION) $ ADDED
!                                                                  COMMAND TO PRINT ALL THE LOADS VERIFICATION
$                  !                                               REPORTS
!                                                                  REPORT-FREQUENCY      = HOURLY       $ DEFAULTS
$                  !                                               FOR LOADS-REPORT
!                                                                  HOURLY-DATA-SAVE      = NO-SAVE   .. $ DEFAULTS
$                  !                                               FOR LOADS-REPORT
!
$                  !
!
$                  !
!                                                                  $******************************DESIGN
$                  !                                               DAYS*******************************
!
$                  ------------------------------                  $ DENVER DESIGN DAYS.  DRY-BULB AND DEW POINT
-------------------------                                          TEMPERATURES FROM 1993 ASHRAE HANDBOOK (CHAPTER
                                                                   24)
INPUT LOADS  INPUT-UNITS = ENGLISH        $DOE-2
DEFAULT(OR METRIC)                                                 WINTER1=DESIGN-DAY                   $ ALL VALUES
             OUTPUT-UNITS = ENGLISH  ..   $DOE-2                   ARBITRARY
DEFAULT(OR METRIC)                                                           DRYBULB-HI= 1            $ (DEG F)
                                                                             DRYBULB-LO= 1            $ (DEG F)
TITLE                                                                        HOUR-HI= 13              $ (HOURS)
LINE-1 *NSF PROJECT *                                                        HOUR-LO= 1               $ (HOURS)
LINE-2 *TEST CASE-1 *                                                        DEWPT-HI= 32             $ (DEG F)
LINE-3 *ONE-ZONE MODEL* ..                                                   DEWPT-LO= 32             $ (DEG F)
                                                                             DHOUR-HI= 15             $ (HOURS)
RUN-PERIOD    FEB 3 2010 THRU FEB 3 2010                                     DHOUR-LO=3               $ (HOURS)
              AUG 25 2010 THRU AUG 25 2010                                   WIND-SPEED= 7            $ (KNOTS)
              JAN 1  2010 THRU DEC 31 2010                                   WIND-DIR= 8              $
..                                                                 0=NORTH,1=NNE ...
```

```
          CLOUD-AMOUNT= 0          $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 1            $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6           $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 77  ..         $ (DEG F)
FROM REFERENCE PART II PAGE VIII.93

SUMMER1=DESIGN-DAY                 $ ALL VALUES
ARBITRARY
          DRYBULB-HI= 91           $(DEG F)
          DRYBULB-LO= 91           $(DEG F)
          HOUR-HI= 13              $(HOURS)
          HOUR-LO= 3               $(HOURS)
          DEWPT-HI= 59             $(DEG F)
          DEWPT-LO= 59             $(DEG F)
          DHOUR-HI= 15             $(HOURS)
          DHOUR-LO= 5              $(HOURS)
          WIND-SPEED= 5            $(KNOTS)
          WIND-DIR= 6              $
0=NORTH,1=NNE ...
          CLOUD-AMOUNT= 0          $
0=CLEAR,10=OVERCAST
          CLOUD-TYPE= 0            $
0=SUMMER,2=FALL/SPRING,1=WINTER
          CLEARNESS= 0.6           $ VARIES FROM
0.5 TO 1.2
          GROUND-T= 81  ..         $(DEG F) FROM
REFERENCE PART II PAGE VIII.93

$ ******************************************
BUILDING LOCATION INFORMATION
************************************************
**********

$ THE LOCATION INFORMATION LATITUDE/ LONGITUDE
AND ALTITUDE HAVE BEEN CHANGED FROM SAMP1E RUN3A
TO RUN THE SIMULATION FOR THE
$ DENVER WEATHER FILE.

BUILDING-LOCATION                $ BUILDING
LOCATION INPUT COMMAND
LATITUDE              = 39.83    $ LATITUDE  FOR
CITY OF DENVER
LONGITUDE             = 104.65    $ LONGITUDE FOR
CITY OF DENVER
ALTITUDE              = 5413.00  $ ALTITUDE FOR
CITY OF DENVER
HOLIDAY               = YES      $ DOE-2.1E
DEFAULT FOR HOLIDAYS = YES (USA-NATIONAL
HOLIDAYES)
TIME-ZONE             = 7        $ TIME ZONE FOR
THE CITY OF DENVER AZIMUTH              = 0
$ BUILDING AZIMUTH / SAMP1E RUN 3A  AZIMUTH =
30/ TESTCASE= 0
DAYLIGHT-SAVINGS      = YES      $ OPTIONS FOR
DAYLIGHT SAVINGS DOE-2.1E  DEFAULTS=YES
GROSS-AREA            = 5000     $ GROSS FLOOR
AREA OF THE CONDITIONED SPACE OF THE BUILDING
HEAT-PEAK-PERIOD      = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
COOL-PEAK-PERIOD      = (1,24)  $ DOE-2.1E
DEFAULT UNUSED
ATM-MOISTURE          =
(0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.7
)
                                 $ UNUSED DOE-
21.E DEFAULTS CALCULATED HOURLY FROM DEWPOINT
TEMP BY
ATM-TURBIDITY  =
(0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.
12,0.12,0.12)
```

```
                              $ UNUSED DOE-
21.E DEFAULTS USED IF WEATHER FILE DO NOT HAVE
SOLAR DATA

X-REF                  = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
Y-REF                  = 0.0000  $ UNUSED DOE-
21.E DEFAULTS CORDINATES TO TRANSLATE BUILDING
LOCATION
SHIELDING-COEF         = 0.2400  $ DOE-2
DEFAULT,THIS COEFFICIENT USED IN SHERMAN
GRIMSRUD INFILTRATION METHOD

TERRAIN-PAR1           = 0.8500  $ DOE-2 DEFAULT
IS A CONSTANT. USED TO MODIFY THE FREE STREAM
WIND SPEED TO ACCOUNT FOR GROUND ROUGHNESS AND
HEIGHT ABOVE GROUND LEVEL AT THE BUILDING SITE
TERRAIN-PAR2           = 0.2000  $ DOE-21.E
DEFAULTS IS A CONSTANT USED TO MODIFY THE FREE
STREAM WIND SPEED TO ACCOUNT FOR GROUND
ROUGHNESS AND HEIGHT ABOVE GROUND LEVEL AT THE
BUILDING SITE.

WS-TERRAIN-PAR1        = 1.0000  $ DOE-21.E
DEFAULTS IS A CONSTANT CORRESPONDING TO TERRAIN-
PART1, BUT FOR THE LOCATION OF THE WIND SPEED
MEASUREMENT; I.E., THE WEATHER STATION.
WS-TERRAIN-PAR2        = 0.1500  $ UNUSED DOE-
21.E DEFAULTS IS A CONSTANT CORRESPONDING TO
TERRAIN-PART2, BUT FOR THE LOCATION OF THE WIND
SPEED MEASUREMENT; I.E., THE WEATHER STATION.
WS-HEIGHT-LIST         = (33.0)  $ DOE-21.E
DEFAULTS
SOLAR-REFL-CALC        = NO-CALC $ DOE-21.E
DEFAULTS
SURF-TEMP-CALC         = NO   ..

$**************************************PARAMETERS
************************************************
*
$**********SCHEDULES**********$

          B-SH-1 =SCHEDULE           THRU JAN 1
(ALL) (1,24)(1)
                                     THRU DEC 31
(ALL) (1,24)(1)  ..

$ BUILDING SHADES (REFERENCE FROM IECC1107.INP
FILE) $

BD1 = BUILDING-SHADE
           X = 0 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..       $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD2 = BUILDING-SHADE
           X = 0 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                    $(FT)
           WIDTH = 5.0                      $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0               $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
```

```
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD3 = BUILDING-SHADE
           X = 20 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD4 = BUILDING-SHADE
           X = 20 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD5 = BUILDING-SHADE
           X = 40 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD6 = BUILDING-SHADE
           X = 40 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD7 = BUILDING-SHADE
           X = 60 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING
```

```
BD8 = BUILDING-SHADE
           X = 60 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD9 = BUILDING-SHADE
           X = 80 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD10 = BUILDING-SHADE
           X = 80 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD11 = BUILDING-SHADE
           X = 100 Y = 0 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD12 = BUILDING-SHADE
           X = 100 Y = 45 Z = 0
$COORDINATES
           HEIGHT = 10.0                   $(FT)
           WIDTH = 5.0                     $(FT)
           AZIMUTH = 90
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 90
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD13 = BUILDING-SHADE
```

```
           X = 0 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                     $(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD14 = BUILDING-SHADE
           X = 8 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24                     $(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD15 = BUILDING-SHADE
           X = 12 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD16 = BUILDING-SHADE
           X = 16 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD17 = BUILDING-SHADE
           X = 20 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD18 = BUILDING-SHADE
```

```
           X = 24 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD19 = BUILDING-SHADE
           X = 28 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD20 = BUILDING-SHADE
           X = 32 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD21 = BUILDING-SHADE
           X = 36 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD22 = BUILDING-SHADE
           X = 40 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING
```

```
BD23 = BUILDING-SHADE
           X = 44 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD24 = BUILDING-SHADE
           X = 48 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD25 = BUILDING-SHADE
           X = 52 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD26 = BUILDING-SHADE
           X = 56 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD27 = BUILDING-SHADE
           X = 60 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
```

```
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD28 = BUILDING-SHADE
           X = 64 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD29 = BUILDING-SHADE
           X = 68 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD30 = BUILDING-SHADE
           X = 72 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD31 = BUILDING-SHADE
           X = 76 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD32 = BUILDING-SHADE
           X = 80 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
```

```
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD33 = BUILDING-SHADE
           X = 84 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD34 = BUILDING-SHADE
           X = 88 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD35 = BUILDING-SHADE
           X = 92 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING

BD36 = BUILDING-SHADE
           X = 96 Y = 0 Z = 18.5
$COORDINATES
           HEIGHT = 24
$(FT)
           WIDTH  = 4                      $(FT)
           AZIMUTH = 180
$(DEGREES)
          TRANSMITTANCE = 0.0              $(0
TO 1),DOE-2 DEFAULT = 0.9
          TILT = 17.74
$(DEGREES),DEFAULT = 90
          SHADE-SCHEDULE = B-SH-1  ..      $
SHADE-VIS-REFL = 0.5  DOE-2 DEFAULT,THESE
COMMANDS ARE USED FOR DAYLIGHTING


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*   BUILDING DESCRIPTION
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******   MATERIALS
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BUILTUP-ROOFING-MAT   = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS             = 0.0313     $(FT)
CONDUCTIVITY          = 0.0939
$(BTU.FT/HR.FT^2.F)
DENSITY               = 70        $(LB/FT^3)
SPECIFIC-HEAT         = 0.35  ..   $(BTU/LB.F)

ROOF-GRAVEL-MAT       = MATERIAL   $
DOE2.1E(REFERENCE 2ND PART X.B.7 MATERIALS
LIBRARY)
THICKNESS             = 0.0417     $(FT)

CONDUCTIVITY          = 0.834
$(BTU.FT/HR.FT^2.F)
DENSITY               = 55         $(LB/FT^3)
SPECIFIC-HEAT         = 0.4  ..    $(BTU/LB.F)

POLY-EXP             = MATERIAL     $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS              = 0.4166     $(FT)
CONDUCTIVITY           = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY                = 1.8        $(LB/FT^3)
SPECIFIC-HEAT          = 0.29  ..   $(BTU/LB.F)

BRICK-4"               = MATERIAL   $
DOE2.1E(FROM REFERENCE 2ND PART X.B.2 MATERIALS
LIBRARY)
THICKNESS              = 0.3333     $(FT)
CONDUCTIVITY           = 0.4167
$(BTU.FT/HR.FT^2.F)
DENSITY                = 120        $(LB/FT^3)
SPECIFIC-HEAT          = 0.2   ..   $(BTU/LB.F)

MIN-WOOL-FIB          = MATERIAL    $
DOE2.1E(FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS             = 0.5108      $ BATT, R-19
CONDUCTIVITY          = 0.0250
$(BTU.FT/HR.FT^2.F)
DENSITY               = 0.60        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)

GYPSUM                = MATERIAL    $
DOE2.1E(HOLLOW GYPSUM BOARD FROM REFERENCE 2ND
PART X.B.6 MATERIALS LIBRARY)
THICKNESS             = 0.0417      $(FT)
CONDUCTIVITY          = 0.0926
$(BTU.FT/HR.FT^2.F)
DENSITY               = 49.0        $(LB/FT^3)
SPECIFIC-HEAT         = 0.2  ..     $(BTU/LB.F)
```

```
AIR-LAYER-HALF-INCH  = MATERIAL   $ DOE2.1E(AIR
LAYER, ¾ IN. OR LESS FOR VERTICAL WALLS FROM
REFERENCE 2ND PART X.B.11 MATERIALS LIBRARY)
RESISTANCE           = 0.9  ..
$(HR.FT^2.F/BTU)

PLASTIC-FILM-SEAL    = MATERIAL   $
DOE2.1E(BUILDING PAPER TYPE FROM REFERENCE 2ND
PART X.B.2 MATERIALS LIBRARY) REPRESENTING TAR-
PAPER
RESISTANCE           = 0.01  ..
$(HR.FT^2.F/BTU)

PLYWOOD-HALF-INCH    = MATERIAL   $ DOE2.1E(FROM
REFERENCE 2ND PART X.B.7 MATERIALS LIBRARY)
THICKNESS            = 0.0417     $(FT)
CONDUCTIVITY         = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY              = 34.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.29  ..   $(BTU/LB.F)

SOFT-WOOD            = MATERIAL    $ DOE2.1E(3/4
IN. FROM REFERENCE 2ND PART X.B.8 MATERIALS
LIBRARY)
THICKNESS            = 0.0625      $(FT)
CONDUCTIVITY         = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY              = 34          $(LB/FT^3)
SPECIFIC-HEAT        = 0.33  ..    $(BTU/LB.F)

SOIL-12IN            = MATERIAL    $ SOIL LAYER
(FROM BUILDING ENERGY SIMULATION VOL. 23, No.6,
PAGES 21-22 WINKELMANN MEMO)
THICKNESS            = 1.0         $(FT)
CONDUCTIVITY         = 1.0
$(BTU.FT/HR.FT^2.F)
DENSITY              = 115         $(LB/FT^3)
SPECIFIC-HEAT        = 0.1  ..     $(BTU/LB.F)

CONCRETE-HE-WEIGHT   = MATERIAL    $ DOE2.1E(4
IN., DRIED AGGREGATE, 140 LB. FROM REFERENCE 2ND
PART X.B.3 MATERIALS LIBRARY)
THICKNESS            = 0.33        $(FT)
CONDUCTIVITY         = 0.7576
$(BTU.FT/HR.FT^2.F)
DENSITY              = 140.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

CONCRETE-BLOCK-8"    = MATERIAL    $
DOE2.1E(CONCRETE FILLED FROM REFERENCE 2ND PART
X.B.6 MATERIALS LIBRARY)
THICKNESS            = 0.6667      $(FT)
CONDUCTIVITY         = 0.4359
$(BTU.FT/HR.FT^2.F)
DENSITY              = 115.0       $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

CONCRETE-LI-WEIGHT   = MATERIAL    $ DOE2.1E(4
IN., 80 LB. FROM REFERENCE 2ND PART X.B.5
MATERIALS LIBRARY)
THICKNESS            = 0.33        $(FT)
CONDUCTIVITY         = 0.2083
$(BTU.FT/HR.FT^2.F)
DENSITY              = 80.0        $(LB/FT^3)
SPECIFIC-HEAT        = 0.2  ..     $(BTU/LB.F)

POLY-EXP-2            = MATERIAL   $ DOE2.1E(4
in. FROM REFERENCE 2ND PART X.B.9 MATERIALS
LIBRARY)
THICKNESS             = 0.3333     $(FT)
CONDUCTIVITY          = 0.02
$(BTU.FT/HR.FT^2.F)
DENSITY               = 1.8        $(LB/FT^3)
SPECIFIC-HEAT         = 0.29  ..   $(BTU/LB.F)

MINERAL-WOOL1        = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
```

```
THICKNESS            = 0.2917       $(FT)
CONDUCTIVITY         = 0.027
$(BTU.FT/HR.FT^2.F)
DENSITY              = 0.6          $(LB/FT^3)
SPECIFIC-HEAT        = 0.2   ..     $(BTU/LB.F)

SOFT-WOOD1           = MATERIAL
$DOE2.1E(MATERIALS LIBRARY, REFERENCED FROM
IECC1107 FILE)
THICKNESS            = 0.2083      $(FT)
CONDUCTIVITY         = 0.0667
$(BTU.FT/HR.FT^2.F)
DENSITY              = 32          $(LB/FT^3)
SPECIFIC-HEAT        = 0.33  ..    $(BTU/LB.F)

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*****   LAYERS
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WA-1-2           = LAYERS          $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800          $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL         = (AIR-LAYER-HALF-INCH,BRICK-
4",PLASTIC-FILM-SEAL,
PLYWOOD-HALF-INCH,MIN-WOOL-FIB,GYPSUM,AIR-LAYER-
HALF-INCH)..  $ MATERIALS FROM OUTSIDE TO INSIDE

WA-1-3           = LAYERS          $ LAYERS FOR
THE EXTERIOR WALL CONSTRUCTION
INSIDE-FILM-RES  = 0.6800          $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL         = (POLY-EXP-2,CONCRETE-LI-
WEIGHT)..  $ MATERIALS FROM OUTSIDE TO INSIDE

ROO-1            = LAYERS          $ LAYERS FOR
THE ROOF CONSTRUCTION
INSIDE-FILM-RES = 0.76             $ HR-SQFT-F
/BTU (REFERENCE FROM IECC1107)
MATERIAL         = (ROOF-GRAVEL-MAT,BUILTUP-
ROOFING-MAT,POLY-EXP,SOFT-WOOD)..
$ MATERIALS FROM OUTSIDE TO INSIDE

DOOR-LAY1         = LAYERS          $ REFERENCED
FROM IECC1107 FILE
MATERIAL          = (GYPSUM,MINERAL-WOOL1,
      SOFT-WOOD1,GYPSUM)   ..

$
************************************************
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***********************************
$
************************************************
*****   CONSTRUCTIONS
************************************************
**********
$
************************************************
************************************************
***********************************

WALL-1            = CONSTRUCTION     $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-2           $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000           $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
```

```
ROUGHNESS         = 3.0000    ..      $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

WALL-2            = CONSTRUCTION      $ EXTERIOR
WALL CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = WA-1-3            $ LAYERS OF
THE EXTERIOR WALL CONSTRUCTION
ABSORPTANCE       = 0.7000            $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000    ..      $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

ROOF-1            = CONSTRUCTION      $ ROOF
CONSTRUCTION (LAYERED CONSTRUCTION)
LAYERS            = ROO-1             $ LAYERS OF
THE ROOF CONSTRUCTION (LAYERED CONSTRUCTION)
ABSORPTANCE       = 0.7000            $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47
ROUGHNESS         = 3.0000  ..        $ DOE-2.1E
DEFAULT FROM REFERENCE PT1 III.47

DOOR-1            = CONSTRUCTION    $ REFERENCED
FROM IECC1107 FILE)
LAYERS            = DOOR-LAY1
U                 = 0.2  ..        $ IECC
2001(RESIDENTIAL BUILDING)(BTU/HR.FT^2.F)

$
************************************************
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***********************************
$
************************************************
*****   WINDOWS/DOORS
************************************************
*************
$
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***********************************

$ THE SIMULATION TOOL (DOE-2.1E) CAN ACCEPT
CUSTOM WINDOWS DESIGNED USING WINDOWS-5 (LBNL)
PROGRAM AS A
$ REASON WINDOWS AND DOORS ARE MODELED USING
WINDOWS-5 (LBNL) PROGRAM FOR CONSISTANCY .

W-1                  =       GLASS-TYPE
$ CUSTOM WINDOW FOR LOWER SOUTH FRONT WALL AND
BACK WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001              $ GLASS
TYPE CODE
PANES                =       1.0000            $ FROM
THE WINDOWS-5 LIBRARY
GLASS-CONDUCTANC =       1.4700            $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS            =       0.9000            $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS         =       0.8400            $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS        =       0.8400            $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000            $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS            =       0.7000            $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..         $ FROM
THE WINDOWS-5 LIBRARY

W-2                  =       GLASS-TYPE
$ CUSTOM WINDOW FOR UPPER SOUTH FRONT WALL
WINDOWS (WINDOWS-5)
GLASS-TYPE-CODE  =       2001              $ GLASS
TYPE CODE
PANES                =       1.0000            $ FROM
THE WINDOWS-5 LIBRARY
```

```
GLASS-CONDUCTANC =       1.4700           $ FROM
THE WINDOWS-5 LIBRARY
VIS-TRANS        =       0.9000           $ FROM
THE WINDOWS-5 LIBRARY
INSIDE-EMISS     =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
OUTSIDE-EMISS    =       0.8400           $ FROM
THE WINDOWS-5 LIBRARY
SPACER-TYPE-CODE =       1.0000           $ FROM
THE WINDOWS-5 LIBRARY (ALUMINIUM)
FRAME-ABS        =       0.7000           $ FROM
THE WINDOWS-5 LIBRARY
CONVERGENCE-TOL  =       0.0000 ..        $ FROM
THE WINDOWS-5 LIBRARY

$
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$
************************************************
*****   OCCUPANCY SCHEDULE
************************************************
*****
$
************************************************
************************************************
***********************************

OC-1            = DAY-SCHEDULE  (1,8) (0.0)
                                (9,11) (1.0)
                                (12,14)
(0.8,0.4,0.8)
                                (15,18) (1.0)
                                (19,21)
(0.5,0.1,0.1)
                                (22,24) (0.0)
..
OC-2            = DAY-SCHEDULE   (1,24) (0.0)
..
OC-WEEK         = WEEK-SCHEDULE  (WD) OC-1 (WEH)
OC-2    ..
OCCUPY-1        = SCHEDULE       THRU DEC 31 OC-
WEEK     ..

$
************************************************
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***********************************
$
************************************************
*****   LIGHTING SCHEDULE
************************************************
******
$
************************************************
************************************************
***********************************

LT-1            =DAY-SCHEDULE       (1,8) (0.05)
                                    (9,18) (1.0)
$OFFICE2 LIGHTING SCHEDULE HAS BEEN SET TO ONE
DURING OFFICE HOURS.
                                    (19,24)
(0.05)..

LT-2            =DAY-SCHEDULE       (1,24) (0.05)
..

LT-WEEK         =WEEK-SCHEDULE      (MON,FRI) LT-
1   (WEH) LT-2  ..

LIGHTS-1        =SCHEDULE           THRU DEC 31
LT-WEEK  ..

$
************************************************
```

```
************************************************
***********************************
$
************************************************
*****   EQUIPMENT SCHEDULE
************************************************
*****
$
************************************************
************************************************
***********************************

EQ-1            =DAY-SCHEDULE      (1,8) (0.02)
                                   (9,14)
(0.4,0.9,0.9,0.9,0.9,0.9)
                                   (15,20)
(0.8,0.7,0.5,0.5,0.3,0.3)
                                   (21,24) (0.02)
..
EQ-2            =DAY-SCHEDULE      (1,24) (0.2)
..
EQ-WEEK         =WEEK-SCHEDULE     (MON,FRI) EQ-1
(WEH) EQ-2  ..
EQUIP-1         =SCHEDULE           THRU DEC 31
EQ-WEEK  ..

$
************************************************
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***********************************
$
************************************************
*****   INFILTRATION SCHEDULE
************************************************
**
$
************************************************
************************************************
***********************************
$
************************************************
************************************************
***********************************
$
************************************************
*****   GENERAL SPACE DEFINITIONS
***********************************************
$
************************************************
************************************************
***********************************

OFFICE                   = SPACE-CONDITIONS
..

$
************************************************
************************************************
***********************************
$
************************************************
*****   SPECIFIC SPACE DETAILS
************************************************
**

$
************************************************
************************************************
***********************************
$
************************************************
************************************************
***********************************
$
************************************************
*****         SPACE1-1
```

```
**********************************************
**
$
**********************************************
**********************************************
**********************************

SPACE1-1             = SPACE
ZONE-TYPE            = CONDITIONED $ DOE2
DEFAULTS
AREA                 = 5000
VOLUME               = 70000
X                    = 0.0000
Y                    = 0.0000      $ DOE2
DEFAULTS
Z                    = 10.0000     $ DOE2
DEFAULTS
AZIMUTH              = 0.0000      $ DOE2
DEFAULTS
MULTIPLIER           = 1.0000      $ DOE2
DEFAULTS
FLOOR-WEIGHT         = 70          $ IECC
2001,402.1.3.3,DOE2 DEFAULTS IS 70
NUMBER-OF-PEOPLE     = 50
PEOPLE-SCHEDULE      = OCCUPY-1
PEOPLE-HEAT-GAIN     = 400         $ DOE2
DEFAULTS
PEOPLE-HG-LAT        = 130.3       $ DOE2
DEFAULTS
PEOPLE-HG-SENS       = 252.2       $ DOE2
DEFAULTS
EQUIP-SCHEDULE       = EQUIP-1
EQUIPMENT-W/SQFT     = 1           $ DOE2
DEFAULTS
AIR-CHANGES/HR       = 0.25        $ DOE2
DEFAULTS
TEMPERATURE          = (73)        $ DOE2
DEFAULTS
SOURCE-TYPE          = ELECTRIC    $ DOE2
DEFAULTS
SOURCE-POWER         = 0.0000      $ DOE2
DEFAULTS
EQUIP-LATENT         = 0.0000      $ DOE2
DEFAULTS
EQUIP-SENSIBLE       = 1.0000      $ DOE2
DEFAULTS
SOURCE-LATENT        = 0.5         $ DOE2
DEFAULTS
SOURCE-SENSIBLE      = 0.4         $ DOE2
DEFAULTS
FLOOR-MULTIPLIER     = 1.0000      $ DOE2
DEFAULTS
LIGHTING-SCHEDULE    = LIGHTS-1
LIGHTING-TYPE        = REC-FLUOR-RV
LIGHT-TO-SPACE       = 0.80
LIGHTING-W/SQFT      = 1.5
DAYLIGHTING         = YES          $ DAYLIGHING
OPTION IS SWITCHED ON
LIGHT-REF-POINT1    = (25,25,2.7) $ LOCATION OF
THE FIRST DAYLIGHT SENSOR
LIGHT-REF-POINT2    = (75,25,2.7) $ LOCTION OF
THE SECOND DAYLIGHT SENSOR
ZONE-FRACTION1      = 0.5          $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 1
ZONE-FRACTION2       = 0.5         $ FRACTION OF
THE ZONE CONTROLLED BY SENSOR 2
LIGHT-SET-POINT1     = 50          $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 1
LIGHT-SET-POINT2     = 50          $ TARGET
ILLUMINATION (FC) REQUIRED AT SENSOR 2
LIGHT-CTRL-TYPE1     = CONTINUOUS  $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 1
LIGHT-CTRL-TYPE2     = CONTINUOUS  $ TYPE OF
LIGHTING CONTROL FOR PORTRION OF ZONE AREA
CONTROLLED BY SENSOR 2
```

```
MIN-POWER-FRAC       = 0           $ LOWEST
INPUT POWER FRACTION FOR CONTINUOUSLY DIMMABLE
LIGHING CONTROL SYSTEM
MIN-LIGHT-FRAC       = 0   ..      $ SPECIFIES
THE FRACTIONAL LIGHT OUTPUT THAT A CONTINUOUSLY
DIMNMABLE
                                   $ LIGHTING
CONTROL SYSTEM PRODUCES AT THE MINIMUM
FRACTIONAL INPUT POWER GIVEN BY MIN-POWER-FRAC

FRONT-1              = EXTERIOR-WALL
HEIGHT               = 8
WIDTH                = 100
X                    = 0
Y                    = 0
Z                    = 0
AZIMUTH              = 180
CONSTRUCTION         = WALL-1
TILT                 = 90.0000   ..   $ DOE2
DEFAULTS

WF-1                 = WINDOW
WIDTH                = 45
HEIGHT               = 4.0000
X                    = 52.5
Y                    = 3.0000
GLASS-TYPE           = W-1   ..

FRONT-2              = EXTERIOR-WALL
HEIGHT               = 8
WIDTH                = 100
X                    = 0
Y                    = 25
Z                    = 16
AZIMUTH              = 180
CONSTRUCTION         = WALL-1
TILT                 = 90.0000   ..   $ DOE2
DEFAULTS

WF-2                 = WINDOW
WIDTH                = 90
HEIGHT               = 3.0000
X                    = 5
Y                    = 4.0000
GLASS-TYPE           = W-2   ..

PR1                  = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129


(100,0,0)(100,50,0)(100,50,8)(100,25,24)
(100,25,16)(100,0,8)  ..
RIGHT-1 = EXTERIOR-WALL   POLYGON = PR1
X                    = 100
Y                    = 0
Z                    = 0
CONSTRUCTION         = WALL-1   ..

DR-1                 = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                = 3
HEIGHT               = 7
X                    = 25
Y                    = 0
SETBACK = 0.0                          $(FT)
CONSTRUCTION         = DOOR-1
$MULTIPLIER          =            UNUSED
$OVERHANG-A          = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B          = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W          = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D          = 0.0        DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE      = 0.0        DOE-2
DEFAULT,UNUSED(DEGREES)
```

```
$LEFT-FIN-A            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF              = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR        = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR        = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS     = 10
INSIDE-VIS-REFL        = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-2                   = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                  = 3
HEIGHT                 = 7
X                      = 22
Y                      = 0
SETBACK = 0.0                           $(FT)
CONSTRUCTION           = DOOR-1
$MULTIPLIER            =              UNUSED
$OVERHANG-A            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE        = 0.0          DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D            = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF              = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR        = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR        = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS     = 10
INSIDE-VIS-REFL        = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

BACK-1                 = EXTERIOR-WALL
HEIGHT                 = 8
WIDTH                  = 100
X                      = 100
Y                      = 50
Z                      = 0
AZIMUTH                = 0
```

```
CONSTRUCTION          = WALL-1
TILT                  = 90.0000   ..    $DEGREES

WB-1                  = WINDOW
WIDTH                 = 24
HEIGHT                = 4.0000
X                     = 11
Y                     = 3.0000
GLASS-TYPE            = W-1  ..

WB-2                  = WINDOW
WIDTH                 = 24
HEIGHT                = 4.0000
X                     = 65
Y                     = 3.0000
GLASS-TYPE            = W-1  ..

PL1                   = POLYGON $ FROM
DOCUMENTATION UPDATE PACKAGE #2 PAGE 2.129


(0,50,0)(0,0,0)(0,0,8)(0,25,16)
(0,25,24)(0,50,8)   ..
LEFT-1                = EXTERIOR-WALL  POLYGON =
PL1
X                     = 0
Y                     = 50
Z                     = 0
CONSTRUCTION          = WALL-1   ..

DR-3                  = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                 = 3
HEIGHT                = 7
X                     = 25
Y                     = 0
SETBACK = 0.0                        $(FT)
CONSTRUCTION          = DOOR-1
$MULTIPLIER           =             UNUSED
```

```
$OVERHANG-A           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE       = 0.0          DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D           = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D          = 0.0          DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF             = 0.0          USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR       = 0.5          $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR       = 0.5          $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS    = 10
INSIDE-VIS-REFL       = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

DR-4                  = DOOR $(REFERENCED FROM
IECC1107 FILE)
WIDTH                 = 3
```

```
HEIGHT                = 7
X                     = 22
Y                     = 0
SETBACK = 0.0                          $(FT)
CONSTRUCTION          = DOOR-1
$MULTIPLIER           =             UNUSED
$OVERHANG-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-W           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$OVERHANG-ANGLE       = 0.0         DOE-2
DEFAULT,UNUSED(DEGREES)
$LEFT-FIN-A           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-B           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-H           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$LEFT-FIN-D           = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-A          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-B          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-H          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$RIGHT-FIN-D          = 0.0         DOE-2
DEFAULT,UNUSED(FT)
$INF-COEF             = 0.0         USED IF
INFILTRATION METHOD=CRACK(0 TO 160)
SKY-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
GND-FORM-FACTOR       = 0.5         $ARBITRARY
VALUE(0 TO 1)
$SHADING-DIVISIONS    = 10

INSIDE-VIS-REFL       = 0.0   ..        $DOE-2
DEFAULT,FOR DAYLIGHTING CALC(0 TO 1)

FLOOR-1               = EXTERIOR-WALL
HEIGHT                = 50
WIDTH                 = 100
X                     = 0
Y                     = 50
Z                     = 0
AZIMUTH               = 180
CONSTRUCTION          = WALL-2
TILT                  = 180.0000   ..   $
REFERENCE FROM BUILDING ENERGY SIMULATION VOL.
23, No.6, PAGE 21 WINKELMANN MEMO

TOP-1                 = EXTERIOR-WALL
HEIGHT                = 30.39
WIDTH                 = 104
X                     = -2
Y                     = -3.95
Z                     = 6.73
AZIMUTH               = 180
CONSTRUCTION          = ROOF-1
TILT                  = 17.7400   ..    $ DOE2
DEFAULTS

TOP-2                 = EXTERIOR-WALL
HEIGHT                = 36.35
WIDTH                 = 104
X                     = 102
Y                     = 52.25
Z                     = 6.55
AZIMUTH               = 0
CONSTRUCTION          = ROOF-1
TILT                  = 32.6200   ..   $ DOE2
DEFAULTS

 $---HOURLY REPORTS---$
```

```
PLTSCH  = SCHEDULE   THRU FEB 3 (ALL) (1,24) (1)
                     THRU AUG 25 (ALL) (1,24)
(1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER1 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (1, 4, 6)   ..  $
CLEARNESS NUMBER, DRY BULB TEMPERATURE (°F),
CLOUD AMOUNT (0 TO 10) FROM REFERENCE PT1
III.101

PLOTER2 = REPORT-BLOCK
          VARIABLE-TYPE = BUILDING
          VARIABLE-LIST = (1, 2, 19, 20, 37)
.. $ BUILDING HEATING LOAD (SENSIBLE), BUILDING
HEATING LOAD (LATENT), BUILDING COOLING LOAD
(SENSIBLE), BUILDING COOLING LOAD (LATENT),
BUILDING ELECTRIC TOTAL FROM REFERENCE PT1
III.103 AND III.104

LDS-REP-1 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH
            REPORT-BLOCK    = (PLOTER1, PLOTER2)
            OPTION          = PRINT   ..

END  ..
COMPUTE  LOADS    ..

INPUT SYSTEMS   INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

               SYSTEMS-REPORT  SUMMARY = (ALL-
SUMMARY)
                               VERIFICATION
= (SV-A)
                                                  REPORT-FREQUENCY
= HOURLY
                                                  HOURLY-DATA-SAVE
= NO-SAVE   ..

               $ SYSTEMS SCHEDULES

FAN-1          =DAY-SCHEDULE       (1,24) (1)
..
FAN-2          =DAY-SCHEDULE       (1,24) (1)
..
FAN-SCHED      =SCHEDULE           THRU DEC 31
(WD) FAN-1 (WEH) FAN-2  ..

HEAT-1      =DAY-SCHEDULE    (1,24) (68)   ..
HEAT-2      =DAY-SCHEDULE    (1,24) (68)   ..
HEAT-WEEK   =WEEK-SCHEDULE   (MON,FRI)  HEAT-1
(WEH)  HEAT-2   ..
HEAT-SCHED  =SCHEDULE        THRU DEC 31   HEAT-
WEEK   ..
COOLOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24) (1)  ..
HEATOFF     =SCHEDULE        THRU DEC 31 (ALL)
(1,24) (1)  ..

COOL-1      =DAY-SCHEDULE    (1,24) (78)   ..
COOL-2      =DAY-SCHEDULE    (1,24) (78)   ..
COOL-WEEK   =WEEK-SCHEDULE   (MON,FRI)  COOL-1
(WEH)  COOL-2   ..
COOL-SCHED  =SCHEDULE        THRU DEC 31   COOL-
WEEK   ..

R1          =DAY-RESET-SCH   SUPPLY-HI=60
SUPPLY-LO=52
                             OUTSIDE-LO=30
OUTSIDE-HI=75  ..
SAT-RESET   =RESET-SCHEDULE  THRU DEC 31 (ALL)
R1  ..
```

```
                $ SYSTEM DESCRIPTION

ZAIR           =ZONE-AIR       OA-CFM/PER=0  ..

CONTROL        =ZONE-CONTROL   DESIGN-HEAT-T=70
DESIGN-COOL-T=76
                               HEAT-TEMP-SCH= HEAT-
SCHED
                               COOL-TEMP-SCH= COOL-
SCHED
                               THERMOSTAT-
TYPE=REVERSE-ACTION  ..

                     $ FOLLOWING AIR FLOWS ARE
FROM RUN 3 SV-A REPORT,
                     $ DIVIDED BY ALTITUDE
MULTIPLIER

SPACE1-1       =ZONE           ZONE-AIR=ZAIR
SIZING-OPTION=ADJUST-LOADS
                               ZONE-CONTROL       =
CONTROL
                               ZONE-TYPE          =
CONDITIONED
                               BASEBOARD-RATING   =
0.00        $ BTU/HR
                               PANEL-LOSS-RATIO   =
0.00        $ BTU/BTU
                               EXHAUST-EFF        =
0.75   $ FRAC. OR MULT.
                               BASEBOARD-CTRL     =
OUTDOOR-RESET
                               THROTTLING-RANGE   =
1.00        $ R
                               ZONE-FAN-KW/FLOW   =
0.0003      $ KW/CFM
                               TERMINAL-TYPE      =
SVAV
```

```
                                         ZONE-REPORTS     =
YES   ..

S-CONT        =SYSTEM-CONTROL  COOLING-SCHEDULE=
COOLOFF
                               HEATING-SCHEDULE=
HEATOFF
                               HEAT-SET-T=65
                               COOL-CONTROL=RESET
                               COOL-RESET-
SCH=SAT-RESET
                               MIN-SUPPLY-T=60 ..

S-FAN         =SYSTEM-FANS     FAN-SCHEDULE=FAN-
SCHED  FAN-CONTROL=SPEED
                               SUPPLY-STATIC=2.0
SUPPLY-EFF=.55
                               NIGHT-CYCLE-
CTRL=CYCLE-ON-ANY  ..

S-TERM        =SYSTEM-TERMINAL REHEAT-DELTA-T=58
                               MIN-CFM-RATIO=0.1
..

SYST-1        =SYSTEM          SYSTEM-TYPE=SUM
                               SUPPLY-CFM
= 7366
                               SYSTEM-CONTROL
= S-CONT
                               SYSTEM-FANS
= S-FAN
                               SYSTEM-TERMINAL
= S-TERM
                               $ ECONO-LIMIT-T
= 65
                               ZONE-NAMES
= (SPACE1-1)
                               HEAT-SOURCE
= ELECTRIC
```

```
                              ZONE-HEAT-SOURCE                                      FAN-PLACEMENT    =
= ELECTRIC                                              DRAW-THROUGH
                              PREHEAT-SOURCE                                        MAX-FAN-RATIO    =
= ELECTRIC                                              1.10   $ FRAC. OR MULT.
                              BASEBOARD-SOURCE                                      MIN-FAN-RATIO    =
= ELECTRIC                                              0.300  $ FRAC. OR MULT.
                              VARIABLE-T                                            NIGHT-VENT-CTRL =
= ON                                                    NOT-AVAILABLE
                              SIZING-RATIO                                          NIGHT-VENT-DT    =
= 1.00 $ DOE-2.1 DEFAULT                                5.0    $ R
                              HEAT-SIZING-RATIO                                     RATED-CCAP-FFLOW
= 1.00 $ DOE-2.1 DEFAULT                                = SDL-C80
                              COOL-SIZING-RATI0                                     COOL-CAP-FT
= 1.00 $ DOE-2.1 DEFAULT                                = SDL-C7
                              RETURN-AIR-PATH                                       COOL-SH-FT
= DIRECT                                                = SDL-C27
                              HUMIDIFIER-TYPE                                       COIL-BF
= ELECTRIC                                              = 0.0370 $ FRAC. OR MULT.
                              SHW-HP-SOURCE                                         COIL-BF-FFLOW
= ZONE                                                  = SDL-C37
                              MAX-HUMIDITY                                          COIL-BF-FT
= 100.00 $ PERCENT                                      = SDL-C47   ..
                              MIN-HUMIDITY
= 0.00   $ PERCENT                                      PLANT1    = PLANT-ASSIGNMENT  SYSTEM-NAMES =
                              PREHEAT-T                 (SYST-1) $ REFERENCE FROM THE IECC1107 FILE
= 45     $ F                                                                        DHW-TYPE     =
                              DESC-CTRL-MODE            ELECTRIC
= 0.00                                                                              DHW-SCH      =
                              DESC-DEW-SET              DHWSCH-1
= 50.00  $ F                                                                        DHW-GAL/MIN  =
                              OA-CONTROL                0.03472   .. $CALCULATED FROM ASHRAE 90.1 USER'S
= TEMP                                                  MANUAL PAGE 7-14
                              SUPPLY-DELTA-T  =
3.37   $ R                                              DHWSCH-1  = SCHEDULE  THRU FEB 3 (ALL) (1,24)
                              SUPPLY-KW/FLOW  =         (1)
0.0011 $ KW/CFM                                                             THRU AUG 25 (ALL) (1,24)
                              MOTOR-PLACEMENT =         (1)
IN-AIRFLOW                                                                  THRU DEC 31 (ALL) (1,24)
                                                        (1)   ..
```

```
PLTSCH2  = SCHEDULE  THRU FEB 3 (ALL) (1,24) (1)
                     THRU AUG 25 (ALL) (1,24)
(1)
                     THRU DEC 31 (ALL) (1,24)
(1)   ..

PLOTER3 = REPORT-BLOCK
          VARIABLE-TYPE = GLOBAL
          VARIABLE-LIST = (8)   .. $ DRY BULB
TEMPERATURE (°F) FROM SUPLEMENT PAGE A.16

PLOTER4 = REPORT-BLOCK
          VARIABLE-TYPE = PLANT1
          VARIABLE-LIST = (1, 2, 3)   .. $ TOTAL
COOLING LOAD (Btu/hr), TOTAL HEATING LOAD
(Btu/hr), TOTAL ELECTRICAL LOAD (Kw) FROM
SUPLEMENT PAGE A.48

LDS-REP-2 = HOURLY-REPORT
            REPORT-SCHEDULE = PLTSCH2
            REPORT-BLOCK    = (PLOTER3, PLOTER4)
            OPTION          = PRINT   ..

END   ..
COMPUTE SYSTEMS   ..
INPUT PLANT     INPUT-UNITS = ENGLISH
$DOE-2 DEFAULT(OR METRIC)
                OUTPUT-UNITS = ENGLISH  ..
$DOE-2 DEFAULT(OR METRIC)

PLANT1 = PLANT-ASSIGNMENT  ..

              PLANT-REPORT  SUMMARY=(PS-A, PS-E,
BEPS)  ..

                $ EQUIPMENT DESCRIPTION

                $ HOT-WATER BOILER

SBOIL1   =PLANT-EQUIPMENT  TYPE=HW-BOILER
SIZE=-999   .. $ AUTOSIZE

          PLANT-PARAMETERS  HERM-REC-COND-
TYPE=AIR  ..

                $ AIR-COOLED RECIPROCATING
CHILLER

CHIL1    =PLANT-EQUIPMENT  TYPE=HERM-REC-CHLR
SIZE=-999  .. $ AUTOSIZE

 PLANT-COSTS      PROJECT-LIFE=25  DISCOUNT-
RATE=5 ..
 ENERGY-RESOURCE  RESOURCE=ELECTRICITY  ..
 ENERGY-RESOURCE  RESOURCE=NATURAL-GAS
ENERGY/UNIT=100000
                  UNIT-NAME=THERMS   ..

END  ..
COMPUTE PLANT   ..
STOP ..
```