Appendix A

Additional Capabilities of DOE-2

DOE-2 has many capabilities in addition to those covered in the main text of this manual; following is a list of some of these capabilities. Items in the list point to other pieces of DOE-2 documentation where you will find the capability as it was presented originally or, in some cases, modified and enhanced. The *Sample Run Book (2.1E)* is referred to in order to demonstrate the simulation method. Because there are other phrases or terms that are often used to reference the capability that may be of interest, we have cross referenced a number of them in this list.

The items in the list appear alphabetically and are not separated into the LOADS, SYSTEMS, PLANT, and ECONOMICS subprograms.

ASHRAE Constructions for Walls and Roofs

Instead of entering a LAYERS command, you can use the ASHRAE pre-specified layers found in the *Reference Manual (2.1A)*, Table 26, pp.III.63-66.

ASHRAE Materials Library

Instead of using the materials library provided in this manual you can use the ASHRAE pre-specified materials found in the *Reference Manual (2.1A)*, Table 8, pp.III.63-66.

ASHRAE Weather Design Criteria

see **Design Day**

Atrium

see **Sunspace**

Building Coordinate System

An X Y Z three-dimensional description of the building and shading surfaces can be entered. The method is described in detail in the *Reference Manual (2.1A)*, p.III.8; additional features are described on p.2.74 of the *Supplement (2.1E)*. Specifying surface coordinates is generally only necessary in three instances:
(1) there are building shades (other than those specified with the window fin and overhang keywords);
(2) daylighting is simulated; or
(3) sunspaces are simulated.

For an example, see p.9.6 of the *Sample Run Book (2.1E)*, Single Family Residence.

Casework Heat Recovery

see **Refrigerated Casework**

Chilled Water Storage

see **Energy Storage**

Cogeneration

using either gas turbine, diesel, or natural gas engines can be modeled. See the writeup on p.5.15 of the *Supplement (2.1E)*, and p.3.39 of the *Sample Run Book (2.1E)*, 31-Story Office Building, LOAD2, Run 5.

Curve Fit

allows you to input new performance curves. Since most vendor-supplied equipment information is provided in the form of curves or tabulated data, you can enter new data and overwrite the curves stored in the program. A detailed description of how to input the data is found on p.IV.180 of the *Reference Manual (2.1A)*. Examples appear on pp.2.11 and 3.64 of the *Sample Run Book (2.1E)*.

Custom Weighting Factors

allow you to tailor the weighting factors used in the load calculations to the building being modeled. This improves the accuracy of the calculation. Custom Weighting Factors are calculated when FLOOR–WEIGHT = 0 is specified for a space. A detailed discussion is found on pp.III.141-153 of the *Reference Manual (2.1A)*. For an example, see Single Family Residence on p.9.6 in the *Sample Run Book (2.1E)*.

Daily Reports

see **Hourly Reports**

Daylighting

simulates control of lighting fixtures in response to the level of natural lighting from the sun, sky, and reflection off the inside surfaces of the space. Both dimming and step control can be modeled. Window shade management to control solar gain and/or glare can be modeled. See pp.2.37ff of the *Supplement (2.1E)*. The example starting on p.10.8 of the *Sample Run Book (2.1E)* covers the method of input and shows the reports available.

Demand Ratchets

allow you to adjust energy demand charges; see the *Supplement (2.1E)*, p.5.8.

Desiccant Cooling

see System Type PTGSD in this manual and the PTGSD writeup on p.3.72 of the *Supplement (2.1E)*.

Desiccant Add-On Units

see writeup on p.3.79 of the *Supplement (2.1E)* for "Add-On (Integrated) Desiccant Cooling", covering both solid and liquid systems.

Design Day

is a feature that allows you to enter the design criteria for outside weather conditions. Peak loads are calculated based on these conditions rather than those on the weather tape. The automatic sizing for systems is based on the design criteria; the plant is sized on the maximum loads that occur during the systems design day run period. See the *Sample Run Book (2.1E)*, p.1.18.

Energy Storage

Hot and cold water storage is described on pp.V.73-81 of the *Reference Manual (2.1A)*. The *Sample Run Book (2.1E)* shows an example of cold water storage on p.2.32 and hot water storage on p.3.15. Ice storage systems are described on pp.4.15ff of the *Supplement (2.1E)* and an example is given in the *Sample Run Book (2.1E)* under "Office Building and Open Atrium", section 7.

Energy Meters

allow you to meter different energy end uses; see the *Supplement (2.1E)*, p.3.4 and p.4.3.

Evaporative Cooling

see writeup on three configurations of evaporative cooling in the *Supplement (2.1E)*:
Stand-alone Evaporative Cooling, p.3.64,
Add-on Evaporative Cooling, p.3.65,
Residential Direct Evaporative Cooling, p.3.70.

Fabric Roof Pressurization

see **Night Ventilation**

Fan Power

can be input using alternative keywords for fan location, total static pressure, and fan efficiency. Most building codes use watts/cfm to determine limits for fan power and the program defaults to these approximate values. However, the alternative capability is often preferred by design engineers. The keywords are discussed on pp.IV.224-227 of the *Reference Manual (2.1A)*. Also, see the *Sample Run Book (2.1E)*, p.2.10.

Functions

see **Input Functions**

Gas Heat Pumps

See p.3.48 of the *Supplement (2.1E)*, for modeling gas-engine-driven heat pumps

Glass Coefficients

for windows is an alternative, and more accurate, method of calculating solar gains through window glazings than the shading coefficient method. See **Window Library**; also refer to p.2.99 of the *Supplement (2.1E)*.

Grocery Store Heat Recovery Systems

see **Refrigerated Casework**

Heat Pumps

with user-defined type of defrost control and of supplemental heat in lieu of electric resistance heat is covered in detail on p.3.26 of the *Supplement (2.1E)*.

Hot Water Storage

see **Energy Storage**

Hourly Reports

are a means of displaying user-selected hourly values calculated by the program. Hourly reports also give daily sums, maxima, minima, and averages. See pp.1.10, 1.29, 1.33 and *Appendix A* of the *Supplement (2.1E)*, and pp.III.127-130 of the *Reference Manual (2.1A)*. The *Sample Run Book (2.1E)* has an example starting on p.10.26ff.

Ice Rink Modeling

see **Refrigerated Casework**

Ice Storage

see **Energy Storage**

Infiltration Modeling

using the CRACK Method is found on p.III.50 of the *Reference Manual (2.1A)*. Infiltration modeling using the Sherman-Grimsrud Method is found on p.2.86 of the *Supplement (2.1E)*.

Input Functions

In LOADS, this allows you to replace DOE-2 code with your own algorithms to model options like non-linear dimming controls, complex window management, etc.

In SYSTEMS, this allows you to replace DOE-2 code with your own algorithms to model things like non-standard economizer controls, control of supply air with a return air controller, etc.

A detailed discussion with numerous examples is found on pp.1.3ff of the *Supplement (2.1E)*. Also, see the *Sample Run Book (2.1E)*, p.10.5 and 10.7.

Input Macros

allow keywords to be set equal to the result of adding, subtracting, multiplying and/or dividing other values. See p.1.42ff of the *Supplement (2.1E)*.

Interior Walls

The different types of interior walls that can be specified (STANDARD, AIR, ADIABATIC, and INTERNAL) are described on pp.2.91ff of the *Supplement (2.1E)*. For a discussion of convective heat transfer across interior walls between a sunspace (atrium) and adjacent space, see the *Supplement (2.1E)*, p.2.9ff.

Life Cycle Cost Analysis

see Economics Component-Costs on p.VI.6 of the *Reference Manual (2.1A)*. See also the *Sample Run Book (2.1E)*, p.1.126ff.

Lighting Control

see **Daylighting**

Load Assignment

is a feature in PLANT that makes it possible to control the operation of plant equipment based on operating range or selection, e.g. switching from a centrifugal chiller to an absorption chiller for peak shaving. See the *Reference Manual (2.1A)*, p.V.52 and the *Supplement (2.1E)*, p.4.47ff. An example is shown in the *Sample Run Book (2.1E)*, p.2.32.

Load Management

is used in combination with load assignment to control the operation of plant equipment based on scheduling requirements, etc. See the *Reference Manual (2.1A)*, p.V.59 and the *Sample Run Book (2.1E)*, p.2.32.

Loads Reports

see *Appendix C* of the *Supplement (2.1E)* for a description of all reports available.

Management of Plant Equipment Operation

see **Load Assignment** and **Load Management**

Mfr's Equipment Data

see **Curve Fit**

Metric Input/Output

allows you to enter and report values in metric (SI) units rather than English (Imperial) units. See the *Supplement (2.1E)*, p.1.35ff.

Meters

Different energy end uses can be assigned to separate meters for energy cost calculations and for reporting. See the *Supplement (2.1E)*, p.3.4 and p.4.3.

Monthly Reports

see **Hourly Reports**

Motorized Drapes or Blinds

see **Window Management**

Natural Ventilation

Enhancements for residential models can be found on p.3.122 of the *Supplement (2.1E)*. The model simulates the amount of air movement through the space due to open windows as a function of wind speed and features of the surrounding terrain. See the *Sample Run Book (2.1E)*, p.11.7.

Night Insulation of Windows

see **Window Management**

Night Ventilation

uses outside air to purge and precool the building, primarily at night. The method can also be used to simulate pressurization of fabric roof arenas. See the *Supplement (2.1E)*, p.3.112ff and the *Sample Run Book (2.1E)*, pp.2.10ff.

Optimum Fan Start

simulates advancing the system start time to bring a building to comfort conditions at start of occupancy. See the *Supplement (2.1E)*, p.3.101ff and the *Sample Run Book (2.1E)*, p.3.13.

Outside Air Economizers (nonstandard)

see **Input Functions**

Parametric Input

is a convenient feature when many DOE-2 runs are necessary. You can change one parameter (or additional related parameters) at the top of the input file and replacements are made automatically in the body of the input. This is especially helpful for the researcher. See the *Reference Manual (2.1A)*, p.II.8.

Peak Integrated Cooling Load

is information that is needed for Thermal Energy Storage Systems. Report SS-J shows both the day on which the peak hour occurs and the day on which the sum of the peaks occur. See the *Supplement (2.1E)*, p.3.139 and *Appendix C*, p.C.88.

Peak Shaving

see **Load Management**

Plant Reports

see *Appendix C* the *Supplement (2.1E)* for a description of all reports available.

Plenums

for return air systems can be found on p.IV.198 of the *Reference Manual (2.1A)*. Note that it is unnecessary to define plenums in both LOADS and SYSTEMS if you request RETURN-AIR-PATH = DUCT. This input is sufficient to simulate light heat from return air vented lighting fixtures. There are other ways to apply the plenum model for areas that are used to vent adjacent spaces; for applicable keywords see p.iii, "Miscellaneous Changes", of the *Supplement (2.1E)*, and p.3.115 for heating of these spaces.

Predefined Input Segments

see **Input Macros**

Refrigerated Casework

applies primarily to food stores where there is considerable interest in recovering the heat from the refrigeration compressors serving the casework. The reason for this is that the cold air off the display cases drops the temperature in the store approximately 10°F, and heating is required even in mild weather. Control of the relative humidity in the space to limit the build-up of frost on the evaporator coils also requires heat. The algorithms can also be used to simulate ice rinks. See the *Supplement (2.1E)*, p.3.103ff and the *Sample Run Book (2.1E)*, p.6.6ff.

Replacing DOE-2 Code

see **Functions**

Reports

Refer to the *Supplement (2.1E)*, *Appendix A: Hourly Report Variable List*, and *Appendix C: Verification and Summary Reports*.

Screw Chillers

DOE-2.1E allows you to simulate screw-type chillers. This is done by entering the performance data of a screw compressor chiller into a reciprocating-type chiller, as described on p.4.26 of the *Supplement (2.1E)*.

Self Shading

When one surface of a building shades another, see p.2.79 of the *Supplement (2.1E)*.

Shading

by adjacent buildings is discussed on p.III.35 of the *Reference Manual (2.1A)* and on p.2.74ff of the *Supplement (2.1E)*. Except for "fins and overhangs" the simulation of shading requires you to input the building surfaces that are involved into a three-dimensional coordinate system; see **Building Coordinate System.** Also, see the *Sample Run Book (2.1E)*, p.4.4, for an example.

Sunspace

is a feature that is used to simulate atria for large buildings and for attached sunrooms for residences. It is possible to simulate the effect of solar radiation through both exterior and interior space glazing. Air movement between spaces can be simulated either by natural convection or forced using a fan. See pp.2.4ff of the *Supplement (2.1E)*, and p.11.1ff of the *Sample Run Book (2.1E)*.

Sun Control Shading

see **Window Management**

Switchable Glazing

that changes from clear to colored depending on ambient conditions can be modeled. An example is electrochromic glass. See p.2.119 of the *Supplement (2.1E)*, and section 6, "Office Building and Atrium Deli/Restaurant", in the *Sample Run Book (2.1E)*.

System Equipment Default Curves

are listed on p.3.141 of the *Supplement (2.1E)*. You should plot and look at the default curves before replacing them with other data.

System Reports

see *Appendix C* of the *Supplement (2.1E)* for a description of all reports available.

System Types

- Single Zone Ceiling Induction (SZCI)
- Ceiling Bypass (CBVAV)
- Two Pipe Induction (TPIU)
- Four Pipe Induction (FPIU)
- Floor Panel Heating System (PH)
- Central Ventilation (HVSYS)
- Packaged Variable Volume/Variable Temperature (PVVT)

- Residential Variable Volume/Variable Temperature (RESVVT)
- Evaporative Cooling (EVAP-COOL)
- Water Loop Heat Pump (HP)
- Sums Zone Loads(SUM)
- User-Defined (FNSYS1)

are the 12 system types that are available in addition to those covered in this manual; they are discussed on pp.IV.33-81 of the *Reference Manual (2.1A)* and in the *Supplement (2.1E).*

Thermal Energy Storage — see **Energy Storage.** Also see "Ice and Eutectic Thermal Energy Storage" on p.4.15ff of the *Supplement (2.1E).*

Three Dimensional Building Input — see **Building Coordinate System**

Trombe Walls — Vented and unvented Trombe walls can be simulated. See p.2.70ff of the *Supplement (2.1E).*

Unconditioned Spaces — such as attics and basements can be modeled. See p.IV.198 of the *Reference Manual (2.1A).*

VAV Systems

Warm-Up Cycle — see p.2.29 of the *Sample Run Book (2.1E).*

Baseboard Heat with Outside Air Reset — see p.2.53 of the *Sample Run Book (2.1E)*

Supply Air Reset — see p.1.26 of the *Sample Run Book (2.1E)*

Venting of Sunspace — see **Sunspace**

Water Cooled Condensers
Water Side Economizers — may be applied to system types PSZ and PVAVS. See p.3.83 of the *Supplement (2.1E).*

Window Library — a library of 200 entries covering commonly-available glazings and experimental electrochromic glazings is discussed in detail on p.2.99 of the *Supplement (2.1E).*

Window Management

to control solar gain or daylight glare; window management is discussed in detail on p.2.35 of the *Supplement (2.1E)*. For examples, see p.2.4 and p.10.4 of the *Sample Run Book (2.1E)*.