Unit Ventilator (UVT)
This simulation is the same as that described for Unit Heater (UHT), except that the unit ventilator is also capable of introducing a fixed amount of outside air during heating and operating an outside air damper for cooling.

BM028

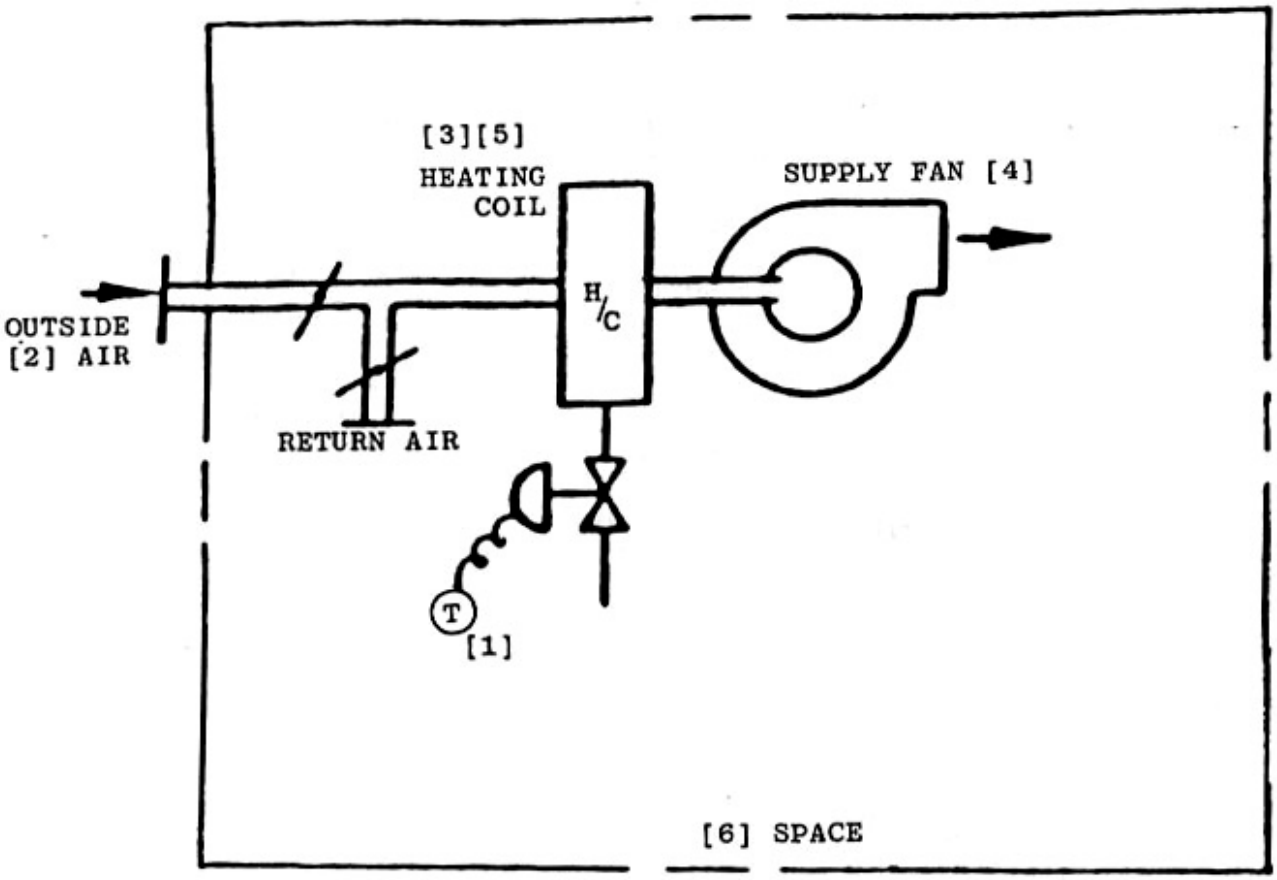

Figure 3.25: Unit Ventilator (UVT)

Suggested minimal input for UVT system:

```
INPUT SYSTEMS ..

SYSTEMS-REPORT  SUMMARY=(SS-A,SS-O) ..

                    $ SYSTEMS SCHEDULES

FANS-ON =  SCHEDULE THRU DEC 31      (WD)    (1,7)(0) (8,18)(1)
                                             (19,24)(0)
                                     (WEH)   (1,24)(0) ..

HEATSETPT = SCHEDULE THRU DEC 31     (WD)    (1,7)(55) (8,18)(72)
                                             (19,24)(55)
```

```
                                        (WEH)    (1,24)(55) ..

DHW = SCHEDULE THRU DEC 31              (WD)     (1,7)(0)
                                                 (8,18)(1.0) (19,24)(0)
                                        (WEH)    (1,24)(0) ..

OFFICE = ZONE           DESIGN-HEAT-T   =   72
                        HEAT-TEMP-SCH   =   HEATSETPT ..   [1]
                        OA-CFM/PER      =   15 ..   [2]

AC-SYST = SYSTEM        SYSTEM-TYPE     =   UVT
                        MAX-SUPPLY-T    =   110   [3]
                        FAN-SCHEDULE    =   FANS-ON   [4]
                        HEAT-SOURCE     =   ELECTRIC   [5]
                                            $ or FURNACE
                                            $ or HOT-WATER with
                                            $ a HWG in PLANT
                        ZONE-NAMES      =   (OFFICE) ..   [6]

P1 = PLANT-ASSIGNMENT   SYSTEM-NAMES    =   (AC-SYST)
                        DHW-BTU/HR      =   10000
                        DHW-SCH         =   DHW ..

END ..
COMPUTE SYSTEMS ..
INPUT PLANT ..
P1 = PLANT-ASSIGNMENT ..
PLANT-REPORT SUMMARY = (BEPS) ..
SHW = PLANT-EQUIPMENT  TYPE = DHW-HEATER  SIZE = -999 ..
```

Description of SYSTEMS Input Instructions

Limitation on the Number of Commands

The maximum number of each SYSTEMS command that the program can accept in a single run is shown below. A building that cannot be specified within these limits should be modeled as two separate buildings.

Command	Maximum Number
DAY-RESET-SCH and/or DAY-SCHEDULE	300 combined
PLANT-ASSIGNMENT	4
RESET-SCHEDULE and/or SCHEDULE	100 combined
SYSTEM	100
SYSTEM-AIR	50
SYSTEM-CONTROL	50
SYSTEM-EQUIPMENT	50
SYSTEM-FANS	50
SYSTEM-FLUID	50
SYSTEM-TERMINAL	50
SYSTEMS-REPORT	1 command (200 reports)
TITLE	5
u-names	180
WEEK-SCHEDULE	200
ZONE	128
ZONE-AIR	50
ZONE-CONTROL	50

Description of SYSTEMS Input Instructions

This section contains descriptions of all SYSTEMS input instructions required to run the SYSTEMS program at a basic level; additional commands and keywords are listed in the *Reference Manual (2.1A)* and the *Supplement (2.1E)*. The order of presentation follows the hierarchy of the *BDL Summary (2.1E)*.

In the previous description of DOE-2 system types, only two commands were used: ZONE and SYSTEM. In the following material, SUBCOMMANDS are re-introduced; remember in the discussion of loads input (LOADS) that SPACE-CONDITIONS was introduced as a sub-command of the SPACE command. Sub-commands are used to "group" keywords of similar meaning and use into a separate list that makes discussion of them a manageable task. You have the option of either separating the input into separate lists using sub-commands or combining them all into one list under the command itself, as we did in the "suggested minimal inputs" for different system types, p.3.10.

The first instruction in the list of SYSTEMS input is

```
INPUT SYSTEMS ..
```

Because schedules in SYSTEMS follow the same pattern of those in LOADS, their explanations will not be repeated here. RESET schedules, however, have some unique rules that need to be covered and the discussion will start with them.

Reset Schedule Instructions

DAY-RESET-SCH and RESET-SCHEDULE

The function of the reset schedule instruction is to define the relationships between a system control parameter and the outside air temperature for each hour of the RUN-PERIOD. The instructions are applicable to control of hot deck temperature, cold deck temperature, and baseboard heating.

RESET-SCHEDULE is almost identical to SCHEDULE. The LIKE keyword is not applicable to RESET-SCHEDULE, but it is applicable to DAY-RESET-SCH. In the DAY-RESET-SCH instruction, rather than entering 24 hourly values, as usually entered for a DAY-SCHEDULE instruction, four keywords and their associated values are entered. All four keywords are *required* if this command is specified.

DAY-RESET-SCH defines how a system control parameter is to vary in response to changes in outside air temperature. A u-name for each DAY-RESET-SCH instruction is required in order to reference it.

An example of a RESET-SCHEDULE is shown in the explanation for the keyword BASEBOARD-SCH (under SYSTEM-CONTROL), p.3.74.

SUPPLY-HI — is the upper supply air setpoint temperature corresponding to the user-input value for OUTSIDE-LO. When this instruction is specified for the reset of cooling air or heating air temperature, the user-input is a temperature. The range, in this case, is from 0.0 to 120.0°F. (See keywords HEAT-RESET-SCH and COOL-RESET-SCH in the SYSTEM-CONTROL subcommand.) Fig. 3.26 illustrates this application. When this instruction is specified for baseboard heating, the user-input is a heating output ratio. (See keyword BASEBOARD-SCH in the SYSTEM-CONTROL subcommand.) The heating output is expressed as a decimal fraction of the maximum zone baseboard heating capacity (see keyword BASEBOARD-RATING in the ZONE-CONTROL subcommand). Fig. 3.27 illustrates this application.

SUPPLY-LO — is the lower supply air setpoint temperature (or output ratio) corresponding to the input value for OUTSIDE-HI; see also the discussion for SUPPLY-HI. The range, for temperature input, is from 0.0 to 120.0°F.

OUTSIDE-HI — is the outside dry-bulb air temperature which corresponds to the input value for SUPPLY-LO (lower supply air setpoint temperature).

OUTSIDE-LO — is the outside dry-bulb air temperature which corresponds to the input value for SUPPLY-HI (upper supply air setpoint temperature). The value for OUTSIDE-LO must *not* be equal to or greater than the value for OUTSIDE-HI (the program will abort and give an error message if this occurs).

BM029

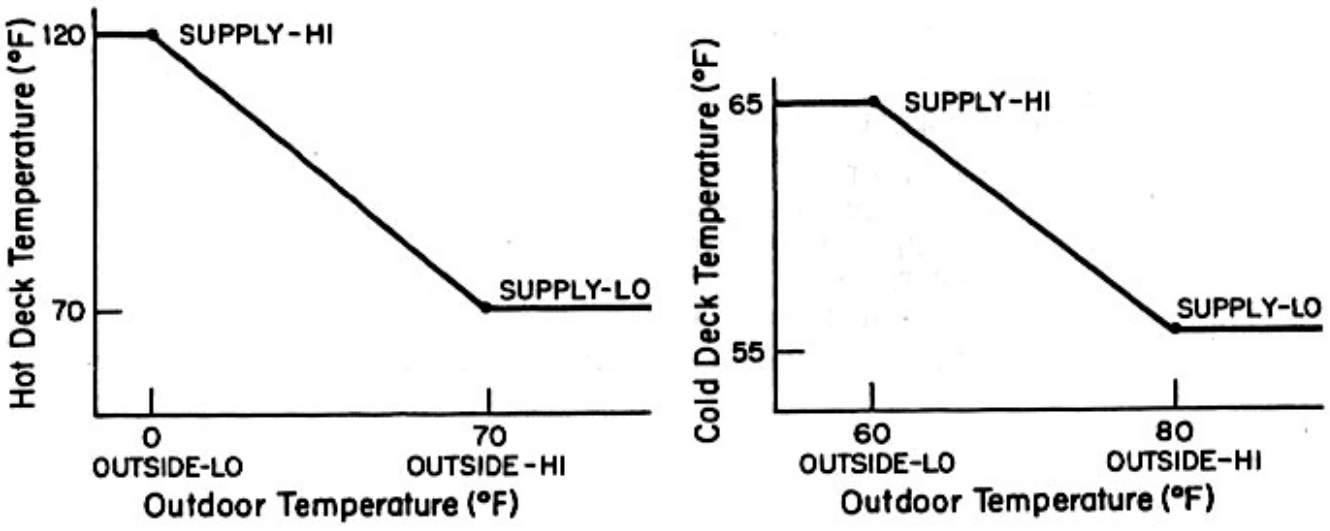

Figure 3.26: Typical DAY-RESET-SCH when used for simulation of hot deck or cold deck temperature control.

BM030

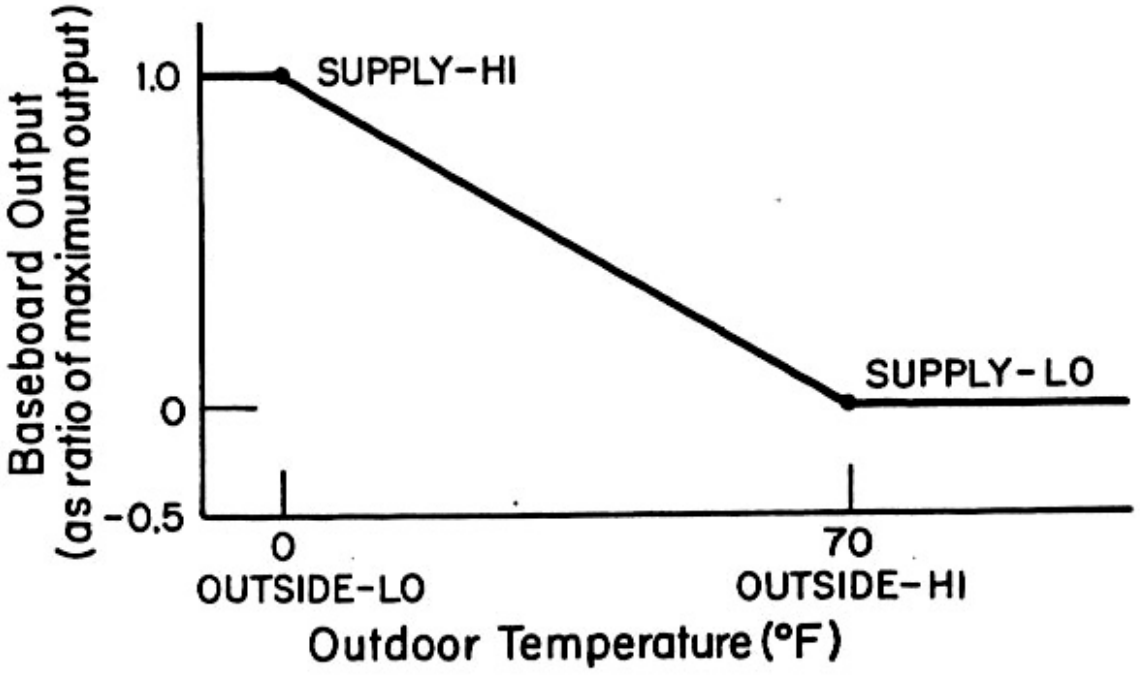

Figure 3.27: Typical DAY-RESET-SCH when used for simulation of baseboard heating output.

DAY-RESET-SCH cannot be nested; that is, the following is **NOT** permitted:

```
RS-1 =    RESET-SCHEDULE  THRU DEC 31  (ALL)
          SUPPLY-HI  = 120
          SUPPLY-LO  =  70
          OUTSIDE-HI =  70
          OUTSIDE-LO =   0  ..
```

The correct input looks like this:

```
DSR-1 =   DAY-RESET-SCH
          SUPPLY-HI  = 120
          SUPPLY-LO  =  70
          OUTSIDE-HI =  70
          OUTSIDE-LO =   0  ..
RS1 =     RESET-SCHEDULE  THRU DEC 31  (ALL) DSR-1  ..
```

ZONE–CONTROL

ZONE–CONTROL provides information on zone temperature control characteristics such as setpoint, thermostat type, and throttling range. A number of ZONE–CONTROL instructions may be entered to account for zone-to-zone variations in these characteristics and/or to permit comparison studies. ZONE–CONTROL is a "subcommand" of the ZONE command and, as such, can be used to input a subset of data to ZONE.

u–name	is required.
DESIGN–HEAT–T	specifies the space temperature that the program uses to calculate the supply air flow rate required to meet peak (or design day) heating loads for the zone. The default is 70°F.
HEAT–TEMP–SCH	is the u-name of the SCHEDULE instruction that specifies the setpoint of the zone heating thermostat. If no data entry is made, the program assumes that the zone has no zone-activated heating control.
DESIGN–COOL–T	specifies the space temperature used to calculate the supply air flow rate required to meet peak (or design day) cooling loads for the zone. The default is 76°F.
COOL–TEMP–SCH	is the u-name of the SCHEDULE instruction that specifies the setpoint of the zone cooling thermostat. If no data entry is made, the program assumes that the zone has no zone-activated cooling control.
BASEBOARD–CTRL	Input for this keyword is a code-word that specifies the method used for controlling the output of the baseboard heating element in the zone. The applicable code-words are:
THERMOSTATIC	(default) temperature control of the baseboard element is by a thermostat located within the zone.
OUTDOOR-RESET	temperature control of the baseboard element is by a thermostat located outside the building.

If code-word THERMOSTATIC is entered, the program assumes that the baseboard element adds heat as required, up to the maximum capacity of the element, to maintain zone temperature within the heating throttling range. The baseboards are sequenced on prior to zone reheat coils (if any) in response to a drop in space temperature.

Note that the italicized words in the left column are *code-words*, not keywords.

THERMOSTAT–TYPE	identifies the type of thermostat action to be simulated. Note that the program assumes the same type of thermostat action for both cooling and heating. The applicable code-words are:
PROPORTIONAL	(default) Thermostat throttles heat addition rate (or heat extraction rate) in linear proportion to the difference between zone setpoint temperature and actual zone temperature. You input the proportional band (see keyword THROTTLING–RANGE).
TWO–POSITION	Specifies an on-off type thermostat (which is simulated as a very narrow fixed throttling range around each setpoint). This code-word is only used for the Residential System (RESYS).
REVERSE–ACTION	In variable air volume systems, this thermostat type allows the air flow rate to go above the design minimum cfm for heating, as defined by MIN–CFM–RATIO. Otherwise, the effect is the same as for THERMOSTAT–TYPE=PROPORTIONAL.
THROTTLING–RANGE	specifies the number of degrees that room temperature must change to go from full heating to zero heating and/or from full cooling to zero cooling. Zone temperature setpoint is assumed to be at the midpoint of the throttling range. This keyword is appropriate to PROPORTIONAL and REVERSE–ACTION thermostats only.

Note that the italicized words in the left column are *code-words*, not keywords.

ZONE–AIR

All air quantities should be input at sea level (standard) values because the program makes a correction for altitude. Input of air quantities corrected for altitude above sea level will result in a double correction. ZONE–AIR is a "subcommand" of ZONE and, as such, can be used to input a subset of data to ZONE.

u–name	is required.
ASSIGNED–CFM	allows you to set (in standard cfm) the design supply air flow rate (sometimes referred to as the recirculated air rate) for the zone. If data entry is omitted for ASSIGNED–CFM and for the following two keywords (AIR–CHANGES/HR and CFM/SQFT), the program will calculate design flow rate based on peak heating/cooling loads calculated by the LOADS program and the temperature differential between design supply and zone conditions. Note that if you want to input design air flow rates and not have the program convert them to sea-level rates, the ALTITUDE keyword in the BUILDING–LOCATION command in LOADS should be set to zero.
AIR–CHANGES/HR	sets the minimum design supply air flow rate that is to be given to the zone. It is expressed in terms of the number of times per hour that this flow rate would replace the total volume of air in the zone. ASSIGNED–CFM takes precedence over this input.
CFM/SQFT	sets the minimum design supply air flow rate that is to be given to the zone. It is expressed as the ratio of the design supply air flow rate (in standard, or sea level, cfm) to the total floor area of the zone. ASSIGNED–CFM takes precedence over this input.

The following keywords are associated with outside ventilation air. Although the specified quantities may be modified by the program for the sake of consistency, the flow of outside ventilation air is an uninterrupted flow as long as the fans are operating.

OUTSIDE–AIR–CFM	sets or specifies the minimum flow rate of outside air (in standard, or sea level, cfm) for the zone.
OA–CHANGES	is the minimum flow rate of outside air for the zone expressed in terms of the number of times per hour that this flow rate would replace the total volume of air in the zone. OUTSIDE–AIR–CFM takes precedence over this input.
OA–CFM/PER	is the minimum flow rate of outside air (in standard, or sea level, cfm) per zone occupant at peak occupancy. OUTSIDE–AIR–CFM takes precedence over this input.

EXHAUST–CFM

is the flow rate (in standard, or sea level, cfm) of direct exhaust from the zone. This data entry can be omitted if there is no exhaust from the zone, or if there is only central exhaust by way of the system return. DOE-2 will not allow MIN–OUTSIDE–AIR to be less than the sum of EXHAUST–CFMs for all zones divided by the sum of supply cfm's for all zones. That is, MIN–OUTSIDE–AIR will not restrict the operation of exhaust fans.

EXHAUST–STATIC

is the total pressure (in inches of water) produced by the exhaust fan serving the zone. This data entry is applicable only if a data entry is made for the keyword EXHAUST–CFM.

EXHAUST–EFF

is the combined efficiency of the zone exhaust fan and motor at design conditions. This data entry is applicable only if a data entry is made for the keyword EXHAUST–CFM. The program calculates exhaust fan horsepower on the basis of the value of this data entry and the entries for the keywords EXHAUST–CFM and EXHAUST–STATIC. The exhaust fan is assumed to be constant flow (not greater than the supply air flow rate) and to operate only when the system supply and return fans operate (see the keyword FAN–SCHEDULE in the SYSTEM–FANS instruction).

EXHAUST–KW

is an alternative to using EXHAUST–STATIC and EXHAUST–EFF. It provides information about the electrical energy consumption of the exhaust fan in this zone. It is expressed in kW consumed by the fan per cfm of exhaust.