ZONE

The ZONE instruction is used to specify information on those secondary HVAC distribution system characteristics specific to a thermal zone. This includes air flow rate (supply air, exhaust air, and outside air), space temperature setpoint, thermostat characteristics, and maximum heating and/or cooling capacity. Each zone to be simulated must also be listed in the ZONE–NAMES keyword of the SYSTEM command for the system serving the zone.

u–name — is required for ZONE; it must match u-name used for SPACE in LOADS

ZONE–CONTROL — takes the u-name of a previously defined ZONE–CONTROL subcommand.

ZONE–AIR — takes the u-name of a previously defined ZONE–AIR subcommand.

BASEBOARD–RATING — is the baseboard heating element capacity for the zone. The input for this keyword should be a negative number.

The following keywords apply only to PIU systems.

TERMINAL–TYPE — specifies the type of terminal serving the zone for a PIU system. The same type of terminal box does not have to be used for the entire system. Typically, a PIU system will contain a mixture of fan powered terminal boxes and regular VAV or constant volume reheat units. The available code-words are:

SVAV — (the default) stands for Standard Variable Air Volume; i.e., regular VAV or constant volume.

SERIES–PIU — indicates that the fan draws air from both the secondary and primary air streams, and that the blower runs all the time.

PARALLEL–PIU — indicates that the fan draws air from the secondary air stream (ceiling plenum) only, and that the blower runs intermittently.

INDUCED–AIR–ZONE — (required keyword) takes as a value the u-name of another zone. It is assumed that the PIU zone is taking its secondary air from the return air of the zone named as the INDUCED–AIR–ZONE. Usually, the core zone, served by a non-PIU terminal, will be designated the INDUCED–AIR–ZONE. Zones with PIU boxes will usually be exterior zones that need the heat reclaimed from the core zone. An exception would be a zone (such as a classroom) where the

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

primary concern is air movement, not energy conservation. In such a case, the corridors can be specified as the INDUCED-AIR-ZONE even though there is no heat to reclaim from them. The program treats this situation in the same way as it does when a core plenum is at a temperature lower than the exterior zone. For zones in which TERMINAL-TYPE = SERIES-PIU or PARALLEL-PIU,

REHEAT-DELTA-T

should be specified (if reheat or booster heat is desired) for the PIU system only. This is a keyword in both the SYSTEM and ZONE commands, and the ZONE level use takes precedence over the SYSTEM level. (At the zone level, this keyword does not apply to any other system types.)

ZONE-FAN-CFM

allows you to size the fan. If ZONE-FAN-CFM is not specified, the program will size the fan assuming series PIU fans. The blower is sized to the zone cfm; i.e., the maximum of the cfm input via ASSIGNED-CFM, AIR-CHANGES/HR, or CFM/SQFT; or the cfm derived from the heating and cooling peaks from LOADS.

For parallel PIU's, ZONE-FAN-CFM must be input. The ZONE level cfm keywords are assumed to refer to the primary air from the central system. The range is from 0.0 to 99999999.0 cfm.

ZONE-FAN-RATIO

allows you to enter a value which sets the ZONE-FAN-CFM as a fraction of the primary air. If both ZONE-FAN-CFM and ZONE-FAN-RATIO are specified, ZONE-FAN-CFM takes precedence.

ZONE-FAN-KW

specifies the power consumption of the fan. The default is .00033 kW/cfm. The range is from 0.0 to 0.01.

ZONE-FAN-T-SCH

is the u-name of a schedule which gives, for zones with parallel PIU's, the space temperature at which the terminal blower turns on. This temperature must be above the heating range. This keyword is required for zones with TERMINAL-TYPE = PARALLEL-PIU.

MIN-CFM-RATIO

should be specified for PIU at the ZONE level. The usual input for PIU terminals should be to specify a ratio that just satisfies the minimum ventilation air requirements of the zone. This keyword applies to other types of VAV systems and will override any value assigned at the SYSTEM level.

MIN-CFM-SCH

is the u-name of a schedule which has values that are to be used in place of the MIN-CFM-RATIO keyword to allow an hourly variation of MIN-CFM-RATIO. This schedule will always override the value specified or calculated for MIN-CFM-RATIO, unless the scheduled value is equal to -999.0 for an hour. When the value is equal to -999.0, then the calculated or specified value of MIN-CFM-RATIO (found on report SV-A for each zone) is used for that hour. This schedule can be used with a value of 1.0 during warmup periods and -999.0 for other hours to simulate full open VAV boxes during a warmup cycle.

SYSTEM–CONTROL

The SYSTEM–CONTROL instruction provides information on supply air temperature (setpoint, control strategy, and limits) and humidity limits, and identifies the appropriate equipment operating schedules. SYSTEM–CONTROL is a "subcommand" of SYSTEM and, as such, can be used to input a subset of data to SYSTEM.

u–name — is required.

MAX–SUPPLY–T — is the *highest allowable temperature for air entering the ZONE(s)*, that is, the highest allowed diffuser temperature. The program will use this value to determine the design air flow rate. This value is also used as an upper limit for supply air temperature control. MAX–SUPPLY–T should be greater than DESIGN–HEAT–T.

HEATING–SCHEDULE — is referenced by the u-name of the SCHEDULE instruction that specifies the time periods (hours and days) during which *heating is available from the plant for this system.* If no data entry is made, the program will assume that heating is always available when needed. A zero value for this schedule means that heating is not available. A non-zero value indicates that mechanical heating is available. If the HEATING–SCHEDULE is set to a value greater than 1.0, the program interprets this value as an outside ambient temperature above which the heating is unavailable or off.

HEAT–CONTROL — Input for this keyword is the code-word that identifies the strategy to be used for control of the heating air temperature leaving the main system heating coil. See COOL–CONTROL for the code-words and a brief description of the control strategy each represents.

HEAT–SET–T — has two main functions depending upon the type of system being specified.

a. For systems that use the keyword HEAT–CONTROL (MZS, DDS, and PMZS), this is the value used as the supply air temperature setpoint when HEAT–CONTROL is equal to CONSTANT; it defaults to MAX–SUPPLY–T.

b. For variable volume systems it is always advisable to input HEAT–SET–T because it enables a main air-handler heating coil; the value assigned is the maximum temperature off this coil. For single duct systems (VAVS, PVAVS, and PIU), the default is MIN–SUPPLY–T (indicating no central heating coil).

HEAT-SET-SCH

is the u-name used to identify the schedule for controlling heating air supply temperature when HEAT-CONTROL = SCHEDULED. For example, define:

```
HOT-COIL-SCH-1 = SCHEDULE
                   THRU APR 30 (ALL) (1,24) (120)
                   THRU SEP 30  (ALL) (1,24) (90)
                   THRU DEC 31  (ALL) (1,24) (120)  ..
```

Then, in SYSTEM, the schedule is referenced by setting

```
HEAT-CONTROL = SCHEDULED
HEAT-SET-SCH = HOT-COIL-SCH-1
```

HEAT-RESET-SCH

is the u-name of the RESET-SCHEDULE instruction that defines the relationship between heating air temperature and outside air temperature, and specifies the days of the year during which this relationship applies. This keyword is used only if the RESET control strategy is selected.

The following is an example. First define:

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

Then, in SYSTEM, the schedule is referenced by setting

```
HEAT-CONTROL = RESET
HEAT-RESET-SCH = HOT-RESET-1
```

MIN-SUPPLY-T

is the lowest allowable temperature for air entering the ZONE(s); i.e., it is the lowest allowed diffuser temperature. The program will use this temperature to determine design supply air flow rate.

COOLING-SCHEDULE

is u-name of the SCHEDULE instruction that specifies the time periods (hours and days) during which *cooling is available from the plant for this system.* If no data entry is made, the program will assume that cooling is always available when needed. A zero value for this schedule means that cooling is not available except through ventilation from an air economizer. A non-zero value indicates that mechanical cooling is available. Additionally, if the schedule has a value greater than 1.0, DOE-2 interprets this value as an outside ambient temperature below which the mechanical cooling is unavailable or off.

COOL–CONTROL

Input for this keyword is a code-word that identifies the strategy to be used for control of the air temperature leaving the system (central) cooling coil. The code-words and a brief description of the control strategy each represents for either heating or cooling are as follows:

CONSTANT

Sets heating supply and/or cooling supply air temperature to a fixed value. Values should then be entered for keywords HEAT–SET–T and/or COOL–SET–T, respectively.

COLDEST

Sets the heating coil (hot deck) temperature each hour to adequately heat the ZONE with the lowest temperature. The limits on the supply air temperature are governed by coil capacities, heating schedules, and MAX–SUPPLY–T.

WARMEST

Sets the cooling coil (cold deck) temperature each hour to adequately cool the ZONE with the highest temperature. The limits on the supply air temperature are governed by coil capacities, cooling schedules, and MIN–SUPPLY–T.

RESET

Specifies use of HEAT–RESET–SCH or COOL–RESET–SCH for control of heating and/or cooling air supply temperature, based upon outdoor air temperature.

SCHEDULED

Specifies use of HEAT–SET–SCH or COOL–SET–SCH for control of heating and/or cooling air supply temperature.

COOL–RESET–SCH

is the u-name of the RESET–SCHEDULE instruction that defines the relationship between cooling air temperature and outside air temperature, and specifies the days of the year during which this relationship applies. This data entry is used only when the RESET control strategy is selected and entry for keyword COOL–CONTROL = RESET.

COOL–SET–SCH

is the u-name used to identify the schedule for controlling cooling air supply temperature when COOL–CONTROL = SCHEDULED.

MAX–HUMIDITY

is the highest allowable relative humidity in the return air from zones served by the system. Because the program calculates the relative humidity in the return air, dehumidification is based on the average humidity condition for all the zones served by the system, as weighted by the relative return air flow rate from each zone. This data entry should be used only for those systems that have the components required for control of excess humidity (i.e., a humidistat and a heating coil downstream of the cooling coil). If no data entry is made, the program will assume that humidity control capability does not

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

exist. The default value of 100% is intended to specify no upper limit on humidity, that is, no humidity control.

DOE-2 will not force the cooling coil to perform beyond its dehumidification capability. The program will not be able to hold a specified MAX-HUMIDITY if MIN-SUPPLY-T is not low enough. Fig. 3.28 shows one type of dehumidification cycle.

MAX-HUMIDITY causes the simulation to function differently for system types SZRH, PSZ, and PVAVS. For SZRH, if the MAX-HUMIDITY level is exceeded, the system reverts to a full reheat. The cooling coil leaving air temperature is driven lower and reheat is added at the fan unit to satisfy the first-named zone. Further, for PSZ and PVAVS systems, specification of MAX-COND-RCVRY will activate the use of condenser recovery to accomplish a similar result. If a lower MAX-HUMIDITY is required to meet desired space conditions, a lower MIN-SUPPLY-T should be entered.

MIN-HUMIDITY

is the lowest allowable relative humidity in the return air from zones served by the system. This data entry should be used only for those systems that have the components required for minimum humidity control (i.e., humidistat and humidifier). If no data entry is made, the program will assume that minimum humidity control capability does not exist. The program simulates the use of a humidifier and the required heat for humidification is passed to PLANT as a steam or hot water load.

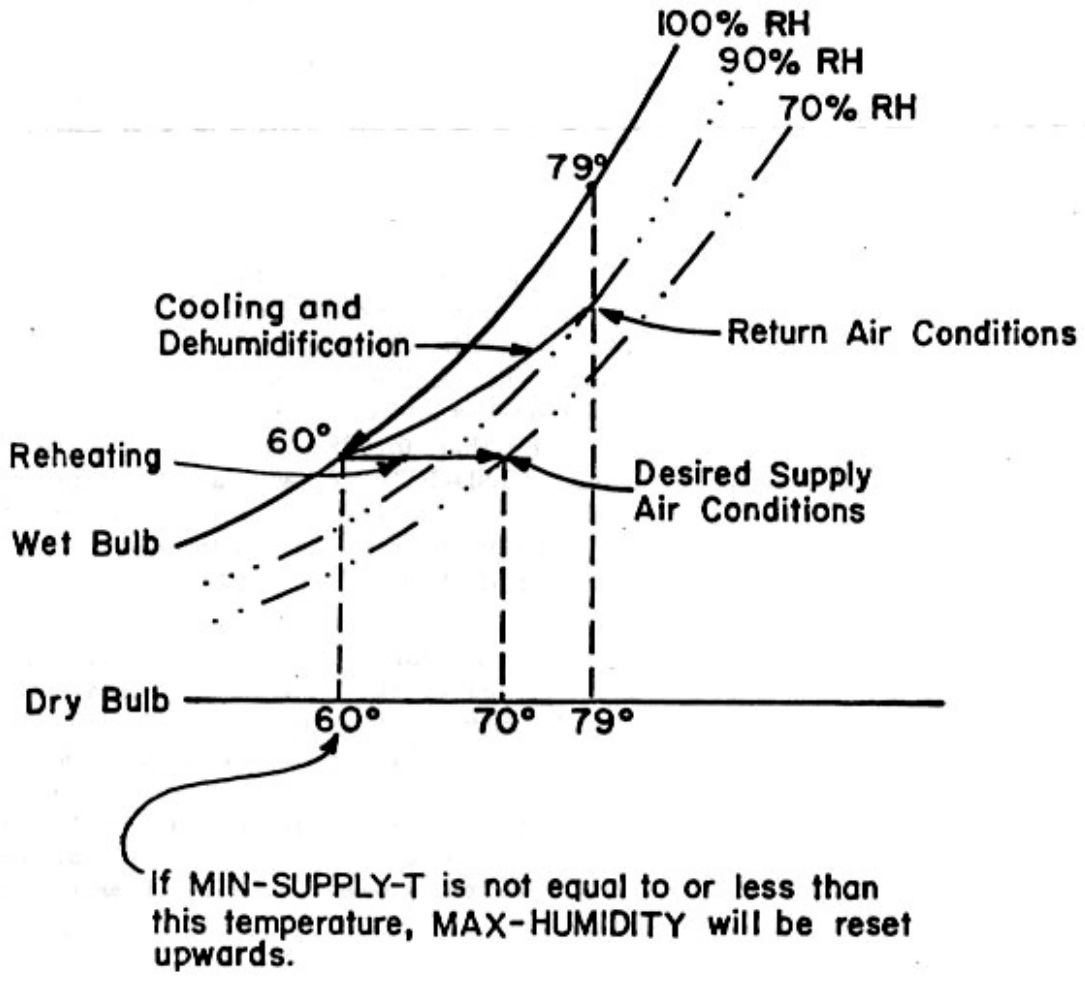

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Figure 3.28: Relationship of MAX–HUMIDITY to MIN–SUPPLY–T

BASEBOARD–SCH — is the u-name of the RESET–SCHEDULE instruction that defines the relationship between baseboard heat output and outside air temperature, and specifies the days of the year during which this relationship applies. This keyword applies only if the ZONE–CONTROL keyword BASEBOARD–CTRL = OUTDOOR–RESET and the capacity is defined using BASEBOARD–RATING = value (negative) at the zone level.

ECONO–LIMIT–T — is the outside air temperature above which the economizer returns to minimum outside air operation as shown in Fig. 3.29. ECONO–LIMIT–T will default to the return air temperature.

PREHEAT–T — is the minimum temperature of air leaving the preheat coil. The SYSTEMS program calculates the necessary preheat coil energy input to maintain this temperature.

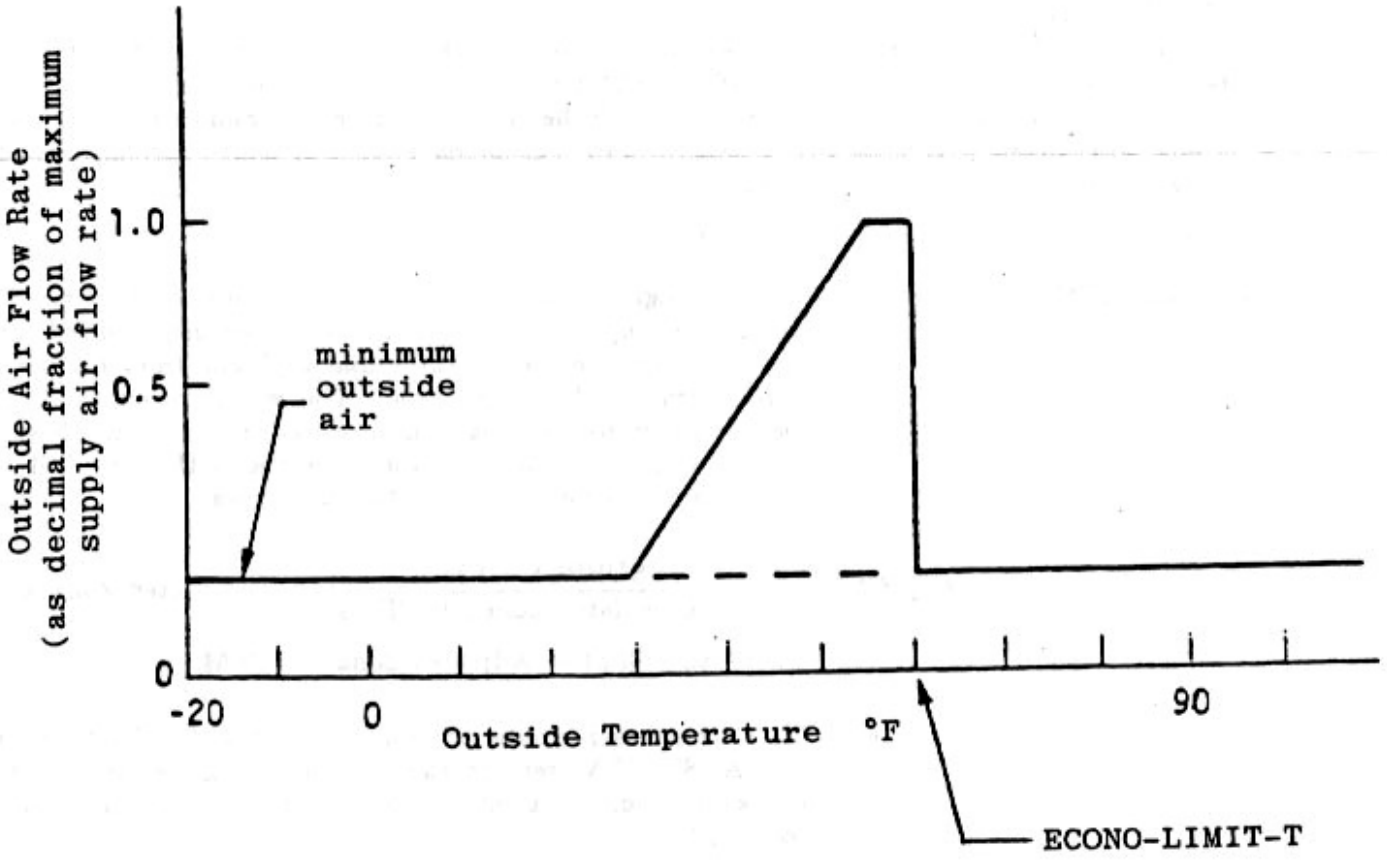

Figure 3.29: Typical curve of air flow vs outside air temperature for systems with temperature type economizer (illustrating use of keyword ECONO–LIMIT–T)

SYSTEM–AIR

The SYSTEM–AIR instruction provides information on system supply air and outside air flow rate. SYSTEM–AIR is a "subcommand" of SYSTEM and, as such, can be used to input a subset of data to SYSTEM. All air quantities should be input as 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.

u–name — is required.

SUPPLY–CFM — is the design capacity (in standard, or sea level, cfm) of the system air supply fan. *This entry is normally omitted, unless fan capacity is a known value and different from the air flow rates calculated by the program.* You will improve the simulation accuracy for existing buildings by inputting known system SUPPLY–CFM. The program proportions the specified total supply air into zone air quantities as follows:

$$\text{Adj. CFM} = \left(\frac{\text{<SUPPLY–CFM>}}{\sum \text{Calculated Zone Air CFMs}} \right) * \text{(Calculated Zone Air)}$$

where Adj. CFM = Adjusted Zone Air CFM.

Note that user-inputs of zone-level ASSIGNED–CFM and EXHAUST–CFM replace the "Calculated Zone Air CFM" in the summation (but only when the latter exceeds calculated zone CFM).

MIN–OUTSIDE–AIR — is the minimum acceptable *constant* flow rate of fresh air, expressed as a decimal fraction of the maximum air supply flow rate. You may alternatively, or additionally, specify outside air quantities at the zone level (keywords OA–CHANGES, OA–CFM/PER, or OUTSIDE–AIR–CFM in the ZONE–AIR instruction). If a value is specified for this keyword and values are also specified for the zone level keywords OUTSIDE–AIR–CFM, OA–CHANGES, OA–CFM/PER, or EXHAUST–CFM, the zone level values take precedence over the system level value. If no zone level value(s) are specified, the value specified here will be used. If MIN–AIR–SCH is used, the value of the outside air flow rate, to be used in the design calculations, should be specified either in this keyword or in the zone level keywords. The program will not allow MIN–OUTSIDE–AIR to be less than the sum of EXHAUST–CFMs for all zones divided by the sum of all supply cfm's for all zones. That is, the exhaust fan operation will override MIN–OUTSIDE–AIR, if MIN–OUTSIDE–AIR is set too low.