COMPUTER CONTROL FOR HEATING, VENTILATING, A-C COMES OF AGE

Computers cost less, energy more. That makes computers practical for HVAC, says James L. Newman

The building owner who investigated computer control of heating and air-conditioning systems 2 years ago only to find it too expensive should take a 2nd look. The reason: rapidly advancing computer technology can now deliver greater control and more flexibility at far less cost than we dared dream of a few years ago.

Many companies now manufacture energy control systems which employ computer technology. While each system is somewhat different, the best of them share a common purpose and attempt to provide similar benefits.

What are these new energy control systems all about? How do they work? What can they do?

The more advanced systems utilize independent microcomputers for each heating / ventilating / air-conditioning (HVAC) unit to monitor and control all activity of that unit. These satellite microcomputers are connected to a host computer via a data highway consisting of 2 twisted pairs of low voltage wires for communication and one pair for power. This multi-drop arrangement, with a microcomputer at each unit, reduces wiring and installation costs while simplifying and improving the control of each system. The host computer merely provides access to the system, via a distributed processing network, to monitor and coordinate certain functions such as peak demand limiting and changing of control set points. This information is then downline loaded to the satellite microcomputers as required.

Common to most computer controlled HVAC systems are such benefits as:

- ✓Peak demand limiting
- ✓Calculated start-up and set-back
- ✓Economizer control and minimum outside air setpoint
- ✓Unit malfunction reporting
- ✓Centralized monitoring of HVAC unit functions
- ✓Battery back-up in the event of power failure

The better designed computer control systems include these features and benefits and also provide:

- ✓Local control at each HVAC unit, rather than all units controlled by the host computer
- ✓Temperature band control
- ✓Simple operation
- ✓Flexibility and ease of making changes to the system at minimum cost
- ✓Troubleshooting of the HVAC system as well as malfunction reporting of a unit problem
- ✓Troubleshooting of the computer system by telephone

The best computerized control systems allow the building operator to squeeze every last BTU out of his building while maintaining occupant comfort level—all at reduced maintenance and operating costs. This cannot be accomplished by all computer controlled HVAC systems.

Following are more detailed explanations of the basic features and benefits outlined above.

Temperature band control: This technique allows a building to use less energy by operating within a temperature range, without affecting occupant comfort. The object is to change the temperature in a zone or zones, without discomfort, and then to let the zone(s) float for as long a period of time as possible before the heating or cooling is again activated. The building owner can establish the temperature bands within which he will allow each zone to float. For example, executive offices could be set at $\pm$ 2° from setpoint, general offices at $\pm$ 3°, and corridors or storage areas at $\pm$ 5° from setpoint. The system minimizes both energy cost and wear and tear on equipment by reducing the number of on/off cycles as a result of not using a heating or cooling stage for as long as possible once it has been turned off.

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Peak demand limiting: Peak demand limiting automatically prevents the amount of power used at peak periods from exceeding limits established by the building engineer. (Utilities charge their customers a premium for high peak-power requirements.) With the most advanced systems, there are no predetermined zones, or loads, which will be shed first when the total demand is projected to go over the setpoints, as with pre-programmed demand limiting systems. Rather, the system checks all zone temperatures and allows only those zones which are farthest from their temperature setpoints to operate, while the others float within preset limits. Thus the hot or cold spots inherent in priority-based systems are eliminated, and comfort conditions are maintained.

In addition, individual stages of heating and cooling can be shed, rather than shutting down an entire unit, thus eliminating the annoying changes in sound levels as fans start up and shut down. This also minimizes the additional maintenance required to change v-belts, a common problem when fans are cycled too often.

Optimized start-up and set-back: Computer control systems allow the building manager to set-back the HVAC system by zone depending on occupancy times. Any changes in occupancy times—because of altered working schedules, for instance—can be easily input to the central computer in advance of the changes.

Some systems even calculate the optimum start-up and shut-down times for each zone depending on outside temperature, zone temperature, building characteristics, and occupancy time. The system maintains in its memory a history of length of time necessary to achieve certain temperature differences and uses this to calculate the optimum times to start up

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and shut down equipment. Each unit is turned on at the latest possible moment to move its own zone up to temperature in the morning. This eliminates the inherent energy waste of a centralized time clock wherein all systems start up at the time required to move the worst zone up to temperature. The same stored information is used, in reverse, to shut the system down at night.

Economizer control & minimum outside air setpoint: Computer control systems can provide centralized setting of the mixed air temperature, and the true minimum percent outside air, for each zone. The manual eyeball method of opening outside air dampers inevitably leads to far greater amounts of air to be cooled or heated than needed. By sensing outside air and return air temperatures, however, the local computer permits the outside air dampers to open only far enough to attain the precise mixed air temperature required. Costs are reduced by taking only the percentage of outside air actually necessary.

Troubleshooting of individual zone malfunction: The central computer in the building manager's office can sound an audible alarm if problems exist in any HVAC equipment. The building superintendent can then pinpoint the problem right at the central computer much of the time by reading and analyzing the various temperatures within that unit and external to it.

Simplicity of operation: By using controlling microcomputers at each HVAC unit, constant resetting and recalibration of temperature controls can be eliminated. The microcomputer can actually set the valves and dampers, according to the temperatures measured before and after the change in setting. Rather than being an overlay to a temperature control system, the more advanced computer systems actually control the HVAC system—not the controls.

Flexibility: Because the newer systems are modular, they can be easily modified if a building is altered or expanded, or if additional buildings are added. If changes to systems are made, reprogramming is a simple and inexpensive task. In the more advanced systems, troubleshooting of computer malfunction, and even reprogramming, can be done by telephone from a more powerful computer at a remote location. Thus, the long wait for a computer technician—a common inconvenience with many earlier systems—can be eliminated. With the newer systems each local computer is identical so that replacement, if necessary, is simple and relatively economical.

Computer control of HVAC systems is definitely here to stay. Building management—in both new and existing facilities—can take a major step toward efficient energy use by carefully investigating its potential.

—**James Newman**